Large Insulating Glass Units – Design Considerations

Insulating glass units in today's wall systems continue to be economical, save energy, and are popular with designers and building owners. Large vision areas are aesthetically pleasing and easy to live with. They provide natural daylight and a connection with the outside world that occupants find enjoyable.

With the improvements made in both the manufacturing of insulating glass units, as well as enhanced energy performance from high performance low emissivity coatings and spectrally selective tinted glass, designers are finding it easier to specify larger and larger unit sizes.

The purpose of this document is to call attention to the issues that accompany the specification of very large insulating glass units, sometimes exceeding 50 square feet in area. Vitro makes no judgment concerning the appropriateness of such large units. The decisions are solely the responsibility of the designer, fabricator and building owner or their representatives.

Safety

Large Insulated Glass Units may require raw-uncut glass to be safely handled in sizes up to and including a 240" width. Handling 240" wide glass creates safety concerns that do not necessarily exist when handling 204" wide glass. Of serious concern is the use of a "normal" spreader bar and slings which allows bowing of the glass pack. This bowing, in the middle of pack, can result in the pack sliding out of the slings and falling on the floor. This would place the employees handling the pack of glass "in the line of fire" at serious risk of injury and /or fatality.

When handling glass packs of greater than 204" wide, **Vitro requires that some type of mechanical device be used that will provide support to multiple areas of the pack regardless of the lite count.** (see photo example below). Mechanical Devices like this replace the spreader bar and slings and are required anytime large format glass that is wider than 204" is being moved.

This example of a mechanical device provides extra support throughout the 240" glass pack that will help eliminate bowing that may occur within the 240" wide pack, regardless of the lite count. Consideration must be given to the weight capacity of the overhead crane being used to handle glass wider than 204" with a mechanical device. These mechanical devices will weigh more than a spreader bar and slings and along with the weight of the glass pack may have a total weight that exceeds the capacity of the overhead crane.

Example of 240" wide pack handling utilizing a Hegla Loading Fork mechanical device at a Vitro facility. Additional information may be obtained at www.hegla.com

Weight

A standard one inch insulating glass unit comprised of 2 lites of ¼" thick glass and a ½" airspace weighs approximately 6 ½ pounds per square foot. Due to the additional weight, large insulating glass units are more likely to incur damage during fabrication, handling, and glazing. The following table shows the calculated weight of a variety of standard one inch insulating glass units.

Standard One Inch Insulating Glass units	
Unit Area (Sq. Ft.)	**Approximate Weight**
20	125
30	198
40	250
50	313
60	395
70	448
80	500

Heat Treating

Larger insulating glass units are more likely to require heat-treating of the glass (either heat strengthening or tempering) to resist design wind loads and thermal stresses. Also, larger heat-treated glass is more likely to have distortion due to the inherent bow and/or warp incurred during the heat-treating processing.

Wind Load

As stated above, larger insulating glass units are more likely to require heat-treating of the glass to resist specified design wind loads. However, while heat-treated glass may prevent breakage with large wind loads, there is no difference in deflection between annealed, heat strengthened and tempered glass. Excessive deflection may cause discomfort and/or be of concern to occupants and must be considered during the building design phase, particularly when large units are specified. The following table compares the calculated center of glass deflection for a variety of insulating glass unit sizes at various assumed wind loads.

Results were determined using the ASTM E1300: *Standard Practice for Determining Load Resistance of Glass in Buildings.*

Calculated Center-of-Glass Deflection Using Assumed 4 Sides Supported Glazing			
	Calculated Center Deflection at Specified Wind Load as Shown		
Unit Size	***30 psf***	***40 psf***	***50 psf***
60" x 84"	0.56"	0.66"	0.74"
60" x 120"	0.80"	0.99"	1.07"
60" x 144"	0.94"	1.13"	1.29"
72" x 120"	1.00"	1.16"	1.29"
72" x 144"	1.21"	1.41"	1.58"
84" x 144"	1.40"	1.61"	1.78"
Shaded results require glass to be heat treated to meet an 8 per 1000 probability of glass breakage.			

Thermal Stress

Larger insulating glass units are more likely to require that the glass be heat-treated to resist thermal stress, particularly when tinted and/or high performance low emissivity coated glass is used. Vitro has long recommended that early design considerations regarding the use of glass on commercial projects include an evaluation of potential thermal stress breakage. To assist designers and others, Vitro has published TD-109: Thermal Stress Update, which is available on its website. In addition, a computerized analysis tool is also available on the website. The appropriate design professional, familiar with the expected project conditions, is best suited to provide the required design conditions that influence thermal stresses in glass. Using the design conditions, either the manual

procedure described in TD-109 or the available computer tool will provide Vitro's recommended glass treatment to resist expected thermal stresses.

The following table is excerpted from TD-109 and shows the influence of insulating glass unit size and glass type on the required heat treatment. The simulations use assumed design conditions that are considered moderate, i.e., neither severe nor benign. The assumed design conditions can be found in TD-109.

Maximum Recommended Annealed Glass Area to Resist Thermal Stresses Using Assumed Design Conditions Based on 8 per 1000 Probability of Glass Breakage		
1" IG Unit with ¼" Glass and ½" Airspace		***Maximum***
Outdoor Lite	***Indoor Lite***	***Unit Area***
Solarban 60 Clear	Clear	35 sf
Solexia	Solarban 60 Clear	22 sf
Solexia	Clear	35 sf
Azuria	Clear	20 sf
Solargray	Clear	30 sf
It is critical to understand that these guidelines are applicable only if design and installation conditions for the intended application are equal to or less severe than those assumed in TD-109. It is the design professional's responsibility to make this judgment and act appropriately.		

Fabrication of Insulating Glass Units

Insulating glass units are fabricated using a variety of processes, ranging from completely manual to very sophisticated automated assembly lines. Regardless of the procedures used, very large insulating glass units can present challenging issues in handling, assembly, and inspection. These include:

- Difficulty in handling and placing spacers that are very flexible, due to their large size.
- Ruptures in spacer welds and seals due to the flexibility of large spacers
- Uniformity and press of the primary seal
- Consistent production and orientation of heat treated glass to minimize objectionable reflective distortion.
- Consistent production and orientation of heat treated glass to avoid glass and/or coating damage to the surfaces **within the sealed air cavity** due to contact caused by the inherent bow of heat treated glass.
- Careful handling is required to prevent glass damage, which is more likely with large glass.
- Careful handling and storage are required to prevent damage to, or even failure of the primary sealant due to shearing stresses caused by the large lites of glass.

Field Related Issues

Care must be exercised when storing and handling any glass product at the job site. Careful handling and storage become even more important with large, relatively expensive insulating glass units. Potential issues related to large insulating glass units include:

- Personal safety – appropriate manpower and/or handling equipment must be used.
- Damage or even failure of the primary seal due to shearing stresses caused by improper handling or storage.

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- Increased incidence of glass damage due to the increased difficulty in handling the larger units.
- Potential glass to glass contact and subsequent damage caused by barometric and/or temperature changes.

Glazing Issues

Attention must be given to the glazing system to ensure that it is properly designed to accommodate large insulating glass units. Among issues to consider are:

- Metal members must be designed to properly support and retain the weight of the unit.
- Excessive deflection of the horizontal sill member can result in water accumulating in the center and not properly draining through the weep system.
- Excessive deflection of adjacent horizontal members can cause glass damage and breakage.
- Setting blocks must be properly sized and located to support the weight of the unit. For example, using industry guidelines: For a 40 square foot unit, two 4" setting blocks would be adequate; however, a 70 square foot unit requires two 7" setting blocks. Setting blocks should be located as close to the quarter points as possible, and never closer than 6" to the end of the mullion.

Accepted industry glazing practice guidelines should be followed. Sources of such guidelines include:

- *IGMA North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.*
- *GANA Glazing Manual*

This document is intended to help Vitro's customers and others give appropriate consideration to the issues and to make informed decisions early in the project design phase. It is not intended, nor should it be construed to be a comprehensive treatment of the potential issues involved with the specification and use of large insulating glass units.

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HISTORY TABLE		
ITEM	DATE	DESCRIPTION
Original Publication	7/26/2005	TD-140
Revision #1	10/04/2016	Updated to Vitro Logo and format
Revision #2	1/28/2019	Updated the Vitro Logo and format
Revision #3	4/26/2021	Updated to include new section on Safety