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The Multi-Light Insulating Glass Debate - To Seal or Not To Seal –

This article was first published by Woodstone in January, 1999.

The seal in all Insulating Glass used in windows and doors will ultimately fail and require replacement, and the decision to use Sealed Insulating Glass, especially in historic Landmark projects, must be carefully considered.

Woodstone specializes in the fabrication of historic replicate windows and doors and the issues relating to the elements used in our products differ significantly from the products provided by stock window and door manufacturers. Essentially, in projects where museum quality replications are required or desired, the useful life of the product must be considered. At Woodstone, not only do we provide accurate window and door replications, we expect our windows and doors to be in service for generations, or at least as long as the windows and doors being replicated were in use, and this prospect creates concerns most window and door manufacturers do not consider.

The adage in historic Landmark replication and restoration circles is this:

If a product is purported to be ‘Maintenance Free’, can it be maintained?

When a ‘maintenance free’ product is damaged or any part of it simply wears out, for all intent and purpose, it must be completely replaced. The first consideration for our clients, then, is to decide whether or not detail replication is worth the investment when compared to the useful life of the product. The following missive weighs the pros and cons of this deliberation.

Background:

Generally, there are two ways of glazing wooden multi-light sashes and doors. While the concept of Sealed Insulating Glass has reportedly been around for a century or more, the application of multiple layers of unsealed single glazing was the primary fabrication technique used to improve energy efficiency until the early 1980s. Today, Sealed Insulating Glass (IG) is not only the most widely used glazing method; it is often specified by building codes requiring energy efficiency and structural performance in conjunction with landmark design conformance.

But, again, not only will the seal in any IG unit fail at some point in time, certain glass types (including but not limited to laminated and other high performance glazing, for example) have a limited useful life, and the glass itself can simply be broken by a stone thrown from a lawn mower, a baseball, a golf ball, or a malicious BB, thereby requiring periodic replacement. So, if you’ve invested in a window or door with custom replicated molding profiles, with brass, bronze or stainless steel hardware, with high performance or restoration glass, and a custom finish on a hardwood with a high resistance to decay, expecting generations of service, it is only prudent to ask the question:

Can your investment be reasonably maintained over the full extent of its expected useful life?

Limited warranties on IG seal failure typically range in duration from none to 10 years. And, recently, some 20 year warranties have become available depending upon the type, size and shape of the IG unit. But IG is warranted for a specific time frame because the IG cannot be expected to perform for a period of time exceeding that specified by its warranty.

The question is, do the benefits of IG out-weigh or off-set the inevitable maintenance cost of IG replacement over the life of a window or door? To answer that question, we have to understand the elements of Window and Door Fabrication, Energy Efficiency, Structural Performance, Aesthetics, Convenience and, most importantly, Maintenance over the Useful Life of the window or door.

Fabrication - Unsealed & Sealed:

For all practical considerations, windows and doors are either single, double or triple glazed. Single glazing assumes that there is one layer of glass separating the interior from the exterior, double glazing assumes that there are two layers of glass, and so on. Some recent glazing methods include layers of transparent materials other than glass. The layering of glass or other transparent materials creates an air space that increases the insulating properties of the window or door. The air space is either **Unsealed**, in which air is permitted to circulate in and out of the air space, or **Sealed**, to prevent air from migrating in and out of the air space.

Unsealed:

Layers of unsealed single glazing typically take the form of a traditional single glazed sash or door set in a common jamb with a second single glazed sash or door or a loosely fit glass panel let into a single glazed sash.

Sealed:

There are, currently, two methods of fabricating multi-light sash and doors with IG. They are True Divided Light (**TDL**) IG and Simulated Divided Light (**SDL**) IG.

TDL fabrication includes traditional full sash thickness muntins and muntin bars separating individual panes of IG. Each IG pane is (or should be) installed from the interior face of the window or door and held in place with interior wooden glazing stops. The IG is bedded in a silicone seal against the exterior rabbet preventing moisture from penetrating the exterior surface of the window or door. The interior glazing stops are not (or should not be) sealed to the interior. Instead, the glazing stops should be applied to the interior glazing rabbet and allowed to breath thereby allowing any moisture that does reach the glazing rabbet to weep or evaporate. It is important that this weeping be allowed to insure that moisture does not accumulate in the glazing rabbet thereby voiding the IG warranty. The use of interior glazing stops also prevents moisture from accumulating in and deteriorating the wood joinery and provides an early warning in the unlikely advent that the exterior silicone seal between the glass and wood has failed. Early detection allows simple maintenance of the exterior seal before any leakage can cause serious damage.

SDL fabrication includes fabrication with one full-light piece of IG bedded in a full-light frame much the same way TDL IG is installed. However, the SDL IG is usually fabricated with internal spacer bars sandwiched inside the sealed air space along with applied moldings simulating the muntin grille laminated to the outside surface of the glass and aligned over the internal spacer bars to simulate the appearance of traditional TDL sash and doors.

ENERGY EFFICIENCY:

IG, in its simplest double glazed configuration, is at least twice as energy efficient as single glazing. Storm sash and storm panels included with single glazing close that gap. But even the simplest IG configuration is more energy efficient than single glazed units with storm panels or storm sash.

IG with Low E coatings and/or various gas inserts are often 2.5 times more energy efficient than traditional single glazing with storm sash or storm panels. And some IG, e.g. Southwall Technologies Heat Mirror, can be as much as 5 times more efficient than single glazing. However, Heat Mirror is rarely used in small pane multi-light sash because it is 2 to 3 times thicker than conventional IG and more expensive per square foot given minimum square foot pricing structures. Furthermore, currently there are drawbacks to gas filled IG units that diminish energy efficiency and longevity requiring that its use be carefully considered as well.

The cost benefit ratio of energy efficiency depends upon the size and insulating characteristics of the building in which the sash or doors are installed, sash or door quantity, size/glass area, location and solar orientation.

STRUCTURAL PERFORMANCE:

Simply put, Sealed IG units resist pressure and impact better than Unsealed units. The degree of increased performance depends upon the type of glass being used. But in all cases, the Sealed airspace provides a cushioning effect. For example, a 10 square foot single piece of double strength glass in an **unsealed** application can withstand nearly 40 psf. That same piece of glass can withstand more than 60 psf in a **sealed** application.

AESTHETICS:

Years ago, small true divided lights in windows and doors were the product of expediency rather than aesthetics. In colonial days, large pieces of glass were not readily available. Small panes of glass were more easily replaced and one might presume that the risk of breakage from an errant bullet, arrow or other missile of the day would have a lesser impact when breaking a small pane in a window or door as opposed to breaking one large pane of glass.

Fenestration, or the arrangement, proportioning, and design of windows and doors in a building, is an important architectural design consideration.

IG allows the appearance of traditional TDL sash and doors from both the interior and the exterior while Storm Sash or Storm Panels obscure that appearance. Of course, TDL single glazed storm sash are also available. But the appearance of two TDL sash or doors juxtaposed in a common jamb is often considered less than attractive, especially when there are many small panes of glass in each sash.

CONVENIENCE:

Insulating glass provides energy efficiency eliminating the need for Storm Windows & Doors or Storm Panels. Typically, storm windows and doors are separate sash installed in a common jamb. Storm panels are usually large panes of glass installed in a rabbet let into a sash or door covering either side of the true divided light muntins. In either case, a Storm Window, Door or Panel is not sealed in place. Air is allowed to circulate from either the exterior or interior into the air space between the Storm Sash and the Primary Sash or Door. In fact, in many applications, air is encouraged to circulate to allow the periodic and inevitable condensation that forms within the airspace to evaporate and escape. Dirt particles, smoke, cooking greases and the like, migrate with the circulating air and accumulate on the glass surfaces requiring regular cleaning. Insects can plug weep holes and also migrate into the air space.

When applied in windows and doors that open and close, Storm Sash or Storm Doors present a second sash or door that must also be opened and closed. Storm Panels are more convenient in windows but present a risk in egress doors. Because the Storm Panel is typically larger in a door, the risk of breakage from vibration or impact with the loosely fit panel is increased. The use of Storm Panels in doors is not usually recommended.

MAINTENANCE:

Unsealed units require regular maintenance, albeit not intensive or costly for the most part on a constant year to year basis. But yearly maintenance is recommended and failure to do so will result in serious long term damage.

All glass surfaces should be cleaned regularly. And there are typically twice as many glass surfaces to clean in an unsealed unit as there are in comparable sealed units.

Glazing stops, glazing putty and points should be inspected yearly and will require varying degrees of maintenance over the years. Because of increased condensation, glazing stops, glazing putty, and, to some extent, glazing points, must be repainted, resealed or replaced on a regular basis. Failure to do so will put the sash or door frame, bars and muntins in jeopardy of wood joinery deterioration. Moisture can seep into the mortise and tenon through the glazing rabbet and rot the sash from the inside out.

Once moisture penetrates the wood joinery, it migrates and tries to escape through the surface of the sash or door typically evidenced by peeling paint. Once the moisture content of the wood increases, repainting is less effective. And with traditional glazing putty and point applications, the glazing rabbet can not be pre-painted because the glazing compound will not adhere to a painted surface.

The glass in layers of single glazed unsealed sash and doors, given the improvements of today's silicone sealants, should be installed from the interior, sealed to the exterior of the glazing rabbet, and held in place with wooden glazing stops. Note that single glazed sash & doors have traditionally been glazed from the exterior side. The glazing stops should not be sealed against the glass in order to allow the inevitable condensation to weep. This fabrication should be used for both the primary sash or door and the storm sash or door.

Storm panels can be installed to either the exterior or interior sides of a properly fabricated sash. Again, Storm Panels are not appropriate for most door applications.

None-the-less, condensation is an unsealed units worst enemy. Not only does condensation impede the view, unless it is minimal or removed during times of concentrated occurrence, it will discolor and deteriorate painted surfaces and rot the wood joinery.

Sealed IG units must be replaced from time to time. It's as simple as that. And replacement is a more intensive and costly process compared to the costs of regularly scheduled maintenance required by an Unsealed unit in one given year.

However, handling and storage are not an issue for Sealed IG units. There are fewer glass surfaces to clean in a Sealed IG unit. Condensation is virtually eliminated by Sealed IG units, thereby eliminating the need for yearly maintenance. And all sash and door surfaces can be pre-painted when initially fabricated with virtually no repainting or resealing required on a year to year basis.

The cost to replace all of the IG in a **TDL** (True Divided Light) multi-light sash or door can cost as much as 20% of the original cost of the entire unit for sash or doors with many panes. On the other hand, if the TDL IG unit is fabricated properly, there is flexibility available in the maintenance consideration - the unit can be converted to a traditional Unsealed Single Glazed format for approximately the same cost as the IG replacement if IG is deemed not necessary or practical.

The cost to replace the IG in an **SDL** (Simulated Divided Light) unit can, and usually will, cost as much as 65% of the original cost of the unit regardless of the number of panes. An SDL unit can not be converted to a traditional Unsealed single glazed format. In fact, the IG in an SDL unit can not be replaced. The entire sash must be replaced because the interior spacer is permanently installed within the sealed airspace and the applied muntin profile moldings, inside and out, are permanently laminated to the exposed faces of the glass. Furthermore, most restoration glass is incompatible with SDL glazing because large sheets of restoration glass aren't strong enough to resist most prescribed wind loads.

CONCLUSIONS:

Again, the question is, do the benefits of IG out-weigh or off-set the inevitable maintenance costs of IG replacement over the useful life of a window or door? The answer, at least today, is - it depends on the duration of the useful life of the product compared to Maintenance, Energy Efficiency, Structural Performance, Convenience and even Aesthetics, all of which being relative considerations.

What are the costs of removing Storm Sash and Doors for cleaning year to year, or seasonally replacing them with screen sash or doors? What are the costs associated with the increased potential for breakage that may result from handling and storage? What is the value of Structural Performance? What is the value of design conformance, building code conformance and your own personal preference? What is the value of Energy Efficiency? Does Convenience have a value? Can the unit be reasonably maintained and, if so, what are the anticipated maintenance costs?

Furthermore, as IG technology improves, how much does that potential improvement offset the inevitable replacement costs. Today, as a rule of thumb, the wider the muntin profile, the more sealant can be applied to the edges of the IG and the longer the IG will perform before seal failure. But whether your muntin profile widths are the minimum 7/8" or you have Simulated Divided Lights with perhaps half again as much perimeter sealant, the warranty tells the tale. On average, IG warranties extend for ten years from the date of manufacture.

At Woodstone, we will fabricate both **Sealed True Divided Light IG** units and multi-layered **Unsealed** units. On the other hand, Woodstone has chosen to not provide **Sealed Simulated Divided Light IG** units. The costs associated with the full replacement of a truly unique product fabricated with **Simulated Divided Light IG**, as opposed to the maintenance of a specific element such as **True Divided Light IG**, are simply too great to justify.

In the final analysis, as long as windows and doors are properly maintained, we expect all of our products to remain useful for generations and we will continue to focus on using the best IG materials and fabrication techniques available to continue to increase the durability and cost effectiveness of our products.

Please refer to Woodstone's Tradition and Technology specification manual or visit our Web Site at <http://www.woodstone.com/index.html> for illustrations of various glazing methods.

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