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GETTING WARMER

Advances in IGU fabrication open up new possibilities

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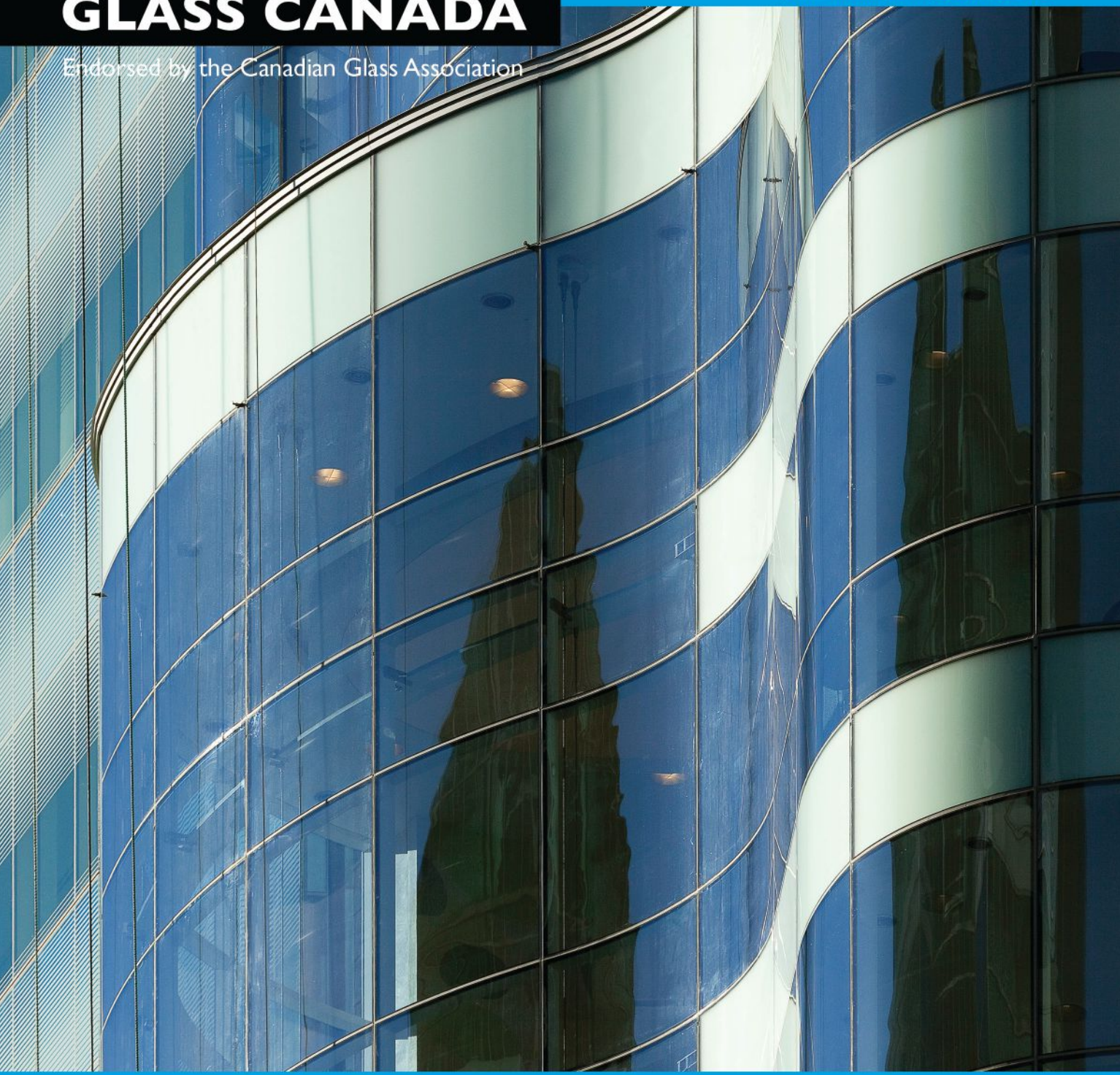

CENTENNIAL GLASS • DAYLIGHTING RAILINGS • 2017 BUYERS GUIDE

GETTING WARMER

by RICH PORAYKO

Advances in insulating glass open new possibilities.

With the recent publication of a Product Category Rule (PCR) for processed glass, the glass industry now has official PCRs for all architectural glass products: flat glass, processed glass and windows and doors. Future green building projects under LEED v.4 and beyond are going to require product lifecycle assessments for all building facade components. This focus on cradle-to-grave life cycle analysis is going to reward fabricators that can build longer-lasting products. We have all heard the concerns about the intense use of insulating glass in high-rise construction and the risk of massive costs down the road as IGUs fail. Baseless as most of those concerns may be, they are out there and architects are thinking about it. The battle for the wall is not over. All this adds up to a powerful incentive in the marketplace to be able to offer the longest possible warranty on an IGU.

Fortunately, we are also at a point in history where technology for making better IGUs is available. Industry associations are developing guidelines for a number of innovative approaches to IGU fabrication that will lead to more reliable gas fill, longer-lasting seals, reductions in PIB migration, vacuum IG, pressure-equalized IGU, unusual IG configurations (shapes, insets, offsets, unsupported edges etc.), triple IGU and more.

Deflategate

Stresses on IG seals from altitude air pressure can be a significant cause of insulating glass failure says Jeff Haberer, director of technical services for Atlanta-based Trulite Glass and Aluminum Solutions and chair of the Insulating Glass Manufacturers Association (IGMA) Technical Services Committee. Regarding altitude, "Traditionally, sometimes fabricators would just ship an IG unit and hope it doesn't break or damage the seal. The most common remedy for relieving the pressure changes due to altitude differences from the manufacturing site to installation site are to insert a small

ABOVE: If we want to keep designing and building big, bright atriums like the one above, we need to find ways to make them energy efficient and long-lasting. Thanks to the hard work of researchers and fabricators, technology is progressing in the right directions.

diameter capillary tube. This tube can be left open or closed at the installation site. If the IG unit is gas filled, the tube would have to be closed until it reaches the installation, opened, and then closed again. You can't leave a capillary tube open if you want the gas to stay in.

"With capillary tubes you get a volume exchange of air every day with differential temperatures, seasonal temperatures and daily pressure changes that will allow a little bit of air in to balance the pressure. However, this bit of air will also bring in some moisture which will eventually deplete the desiccant in the IG unit. Calculations show that if you put desiccant in all four sides of the unit, you can typically expect about a 20-year life span which would more than cover a 10-year warranty. If you are only filling one leg or two legs, you will reduce that life expectancy proportionally."

There are ideas out there other than just putting in a capillary tube which shortens the life of the unit. "Some companies are trying to build pressurized units so it is compensated before it leaves the factory," says Haberer. "If the fabricator is located at a lower altitude and is shipping to say, Denver, at a mile high, they would adjust the IG unit based on its size for the pressure at that altitude of the installation. It is one of the techniques that is being explored." Another method includes drilling a hole in the glass, taping over the hole, taking the unit to altitude and then permanently closing the hole once the pressure has equalized. According to Haberer, there are others that are installing valves in that you can open up at altitude and then close and seal permanently.

Illegal migration

With respect to the PIB primary seals of IGU's there are two concerns being addressed by the industry today. PIB migration is one thing, PIB movement is another. "PIB migration is typically where you see PIB move than an inch into the vision area. It typically appears as a drip from the top of the IG unit." says Haberer. "It could be a potential breakdown of the PIB. It could be a contamination with a solvent. It could be the result of UV and heat attacking the sealant.

"There are rumors of several jobs with PIB migration out there and a lot of opinions on what causes it," says Haberer. Many of them are in litigation so it is hard to get exact information. The Glass Association of North America and IGMA have a joint task force to publish information on what fabricators and glaziers should be looking for – considerations for compatibilities, possible causes, what the PIB should look like in terms of its rheology properties, resistance to flow, molecular weight and more.

Insulating glass units are often thought of as a pressure vessel. "They are dynamic. They pump and move," says Haberer. "PIB is not a cured sealant. It remains tacky, even 20 years later. You can pull an IG unit apart and the PIB is still the same consistency. It has actually the same chemical formulation as chewing gum. It will move as the glass in the IGU deflects in both directions. So is the seal gets worked at the edge. If it's worked too much, it will get voids or small pathways for moisture to get through or for gas to leak out.

"PIB movement which is less than one inch is typically caused by excess pressure on the IGU edge from the glazing system," says Haberer. "In the commercial world it's often a pressure plate that is squeezed too much resulting in an extrusion of the PIB material into the vision area. PIB migration, as noted earlier, is a longer, more dripping effect. PIB movement is usually the result of a glazier who has torqued too much on the pressure plate."

The pressure plates go around all four edges of the unit. It's a little like tightening the lug nuts on your car. If you tighten down two on one side and then tighten the other side, you can put more pressure where you first tightened. "It is preferred to tighten lightly to start, alternating sides, and then gradually cinch up," says Haberer. "Labour is very expensive today and it takes time so people tighten them down as quickly as they can. It is often not done the ideal way. And depending on the temperature of day you tighten them, the fasteners may seasonally expand or contract adding more pressure."

Building better systems

Fabricators willing to innovate are coming up with some whole-system solutions that are achieving eye-popping performance specs. "Windows are such an important part of our living and working spaces," says Greg Clarahan, president and CEO of Alberta-based LiteZone Glass. "However, thermally inefficient windows have been the weakest link in designing energy-efficient buildings. Over the years, the industry has improved the insulating value of windows however the problem with one-to two -inch thick IGUs is that there just isn't enough insulation through the spacer and frame to achieve the very high insulating values that the world needs today."

Clarahan explains that LiteZone is a new kind of insulating glass unit that embraces the need for thicker IGUs to allow for the larger thermal breaks that are needed to achieve very high insulating window values. "LiteZone can be thicker because it relieves the pressure that can build up in the unit with changing temperatures. It uses a system that allows the equalization without allowing water vapour to enter the unit." This allows LiteZone to add layers within the unit of suspended P.E.T. films. "And by varying the number of films, low-E coatings and the thickness of the unit, we can achieve insulating values as high as R-19.6 centre-of-glass and R-17 for the overall window including the glass and frame," says Clarahan.

"LiteZone has addressed all of the weaknesses of traditionally constructed IGUs," Clarahan claims. "Our edge seal has a stronger connection and is much more flexible. This allows it to more easily withstand stresses from wind loads. We've gone to great care to make sure there is minimal differential expansion between the glass and other materials. Higher-performing traditional insulating glass units are under a lot more stress. The difference in temperature between the outside lite of glass and the inside lite of glass on a hot or cold day is greater than if you have a poor-performing glass unit. With poor-performing units, energy flows through the unit and keeps the IG at a fairly uniform temperature. When you increase the insulating value, the difference in temperature between the inside and outside glass lite will be much greater. The outside glass will go through more temperature cycling so there is quite a bit more stress on the edge seals through expansion and contraction and that can become a problem, especially for larger traditional glass units."

Internal pressure that increases and decreases with changing temperatures and solar loads also causes stress on a traditional unit. The glass goes concave or convex which puts stress on the edge seals and can eventually cause a seal failure. "We solved that problem," says Clarahan. "LiteZone is pressure-equalized so there is negligible stress on its edge seals due to changing internal pressures. This also allows us to ship anywhere without concern about changes in atmospheric pressure at different elevations."

Water migration happens with all traditional sealed units. Water vapour will migrate in. It happens at different rates depending on the sealants used, environmental conditions and the workmanship of the sealed unit, however eventually water migration will overwhelm the internal desiccant and it will fail even if the edge seal is not broken. Gas will also migrate out, so argon is lost. "With LiteZone, we don't rely on argon because we embrace the need for thickness to achieve the performance we want. And our edge seal is impermeable to water vapor because it is wrapped in stainless steel foil so water cannot migrate in.

"Conventional multi-layer glass units require multiple edge seals which can be problematic," says Clarahan. "Each edge seal has a risk of failure due to stress and has potential for things that can go wrong. LiteZone only has two seals, no matter how many layers, which reduces the risk of failure."

The thicker you make traditional sealed units, the more stress they will be under. "We've addressed all of the issues that would otherwise limit an IGUs thickness. We have stronger but more flexible edge seals and the units are pressure equalized. LiteZone is air filled and has no concerns with deteriorating performance with the loss of argon over time. We have completely stopped the flow of water vapour through the glass edge."

According to Clarahan, LiteZone's fiberglass spacer is very strong but flexible where the glass connects and has nearly the same coefficient of expansion as glass, which minimizes differential expansion due to changing temperatures. "Because the spacer is so stiff in the transverse direction, even large units have minimal deflection under wind loads. This helps ensure the life of the edge seals with less reliance on the strength of window frames to minimize IGU stress during high winds.

"To truly achieve a sustainable built environment, we need to use long-lasting materials," says Clarahan.

"That's why LiteZone has been designed to last more than 60 years – similar to the life of a building. The widespread use of LiteZone would profoundly reduce the energy required to heat and cool buildings everywhere while dramatically improving human comfort and quality of spaces where people live and work.

Space age

"Silicone spacers have been in the market for over 30 years and have a proven track record of performance, sight line aesthetics and longevity," says Joe Erb, commercial sales specialist for Quanex Building Products. "Super Spacer TriSeal structural warm edge spacer system is silicone-based technology so it is UV resistant and promotes compatibility with other structural silicones. It is thermoset, which gives it the ability to keep its shape while providing a cushioning effect to dampen or soften edge stresses on insulating glass units. These are attributes that contribute to sustainable IG design."

According to Erb, TriSeal enables a captive PIB as the spacer has a third, pressure-sensitive adhesive that helps keep the PIB contained in a pocket rather than just extruded onto the side of a spacer. "When the unit goes through expansion and contraction in cycling, you are not only reducing the stresses on the edge seal but you are also containing the primary seal which is your true moisture barrier. TriSeal's integral desiccant, which is integrated into all four legs of the IG, adds to the longevity."

Glass is getting bigger and heavier in the architectural world. Sightline becomes a very critical point for architects and building owners. "Rigid spacers claim they won't sag into the sight lines, however in reality, on these long spans, we hear concerns of sightline encroachment and inconsistency," says Erb. "Robotics allows the spacer to be applied with extreme accuracy in short and long spans, all the way around the perimeter.

"It's an integrated spacer technology hence the automated approach," says Erb. "Less hands touching the most critical steps. There is the engineered design of the product which is the componentry and the way that it works. Then there is how it is actually assembled into an IGU and the fact that we take those critical manufacturing steps with touch points like PIB application, desiccant filling, spacer bar handling and we bring those online via robotics. TriSeal gives you the best in warm edge attributes plus all of the manufacturing benefits."

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