Dow Performance Silicones

The Use of DOWSIL™ 995 Silicone Structural Adhesive in Retrofit Protective Glazing Installations

DOWSIL™

Tech Talk

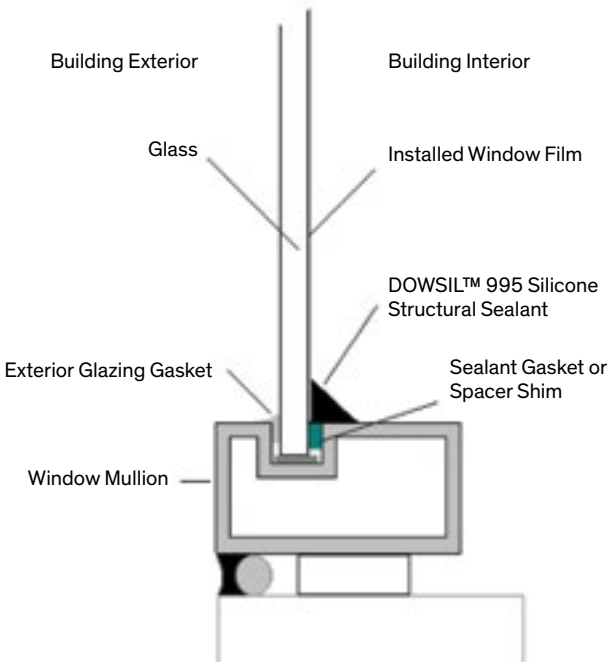
It's hard to imagine an office building without windows. No one doubts the aesthetic value of glass from both interior and exterior perspectives, but glass can create certain hazards that only now are being recognized and resolved. One solution transforms window glass from a hazard in the event of severe weather, terrorist attack or simple breakage into a component of a building's defenses. These systems help maintain the integrity of the glass in the frame, not only reducing the risk to occupants and passersby, but also reducing the amount of building damage that can occur during severe weather and seismic events.

Converting windows from a hazard to a defensive asset requires that (1) the glass is held together even when broken and (2) the window lite remains attached to the frame. Window systems developed to meet these requirements are comprised of a tough, transparent polyester film adhered to the window glass and DOWSIL™ 995 Silicone Structural Adhesive, used as a glazing sealant to anchor the edges of the film and to hold the lite in the supporting frame. These systems have proven effective when evaluated for blast or impact resistance.

Each of the hazards noted above has slightly different needs and requirements. Any system proposed must be evaluated for specific requirements and must be used only as tested. For example, a system that can withstand a 4-psi bomb blast may not be acceptable for a hurricane application or one with a 10-psi blast requirement. Performance depends upon the flexibility and strength of the entire system, including the film, sealant and frame. Therefore, the glazing sealant joint must be designed with a thorough understanding of the flexibility and strength of the whole window film system. A joint that performs well with one type of window film may not perform as well with a different type of film.

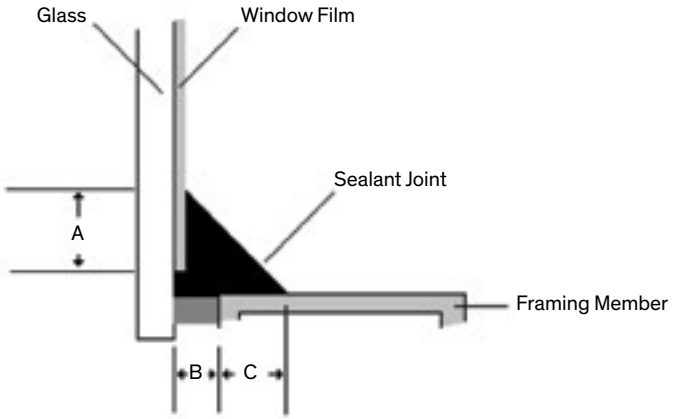
The sealant attachment systems that are economically viable in retrofit applications are built around a triangular joint connecting the film to the supporting framing member. To achieve acceptable performance, a very high-performance sealant must be used. The following information documents some of the key parameters that have proven critical for proper sealant application in high-performance protective glazing systems and provides examples of application issues that could affect system performance.

Figure 1. Application utilizing a triangular bead of DOWSIL™ 995 Silicone Structural Adhesive



Looking specifically at the sealant joint geometry, several areas are important to consider and control. Figure 2 illustrates a triangular sealant joint.

Figure 2. The triangular joint is the most common, acceptable joint design



A: **The sealant bite onto the attached film**. To ensure sealant adhesion and ultimate performance, a minimum sealant bite of 1/4 inch is required for any sealant cap bead. Many high-performance applications designed to withstand an applied force are built around a sealant bite of 3/8 to 1/2 inch that has proven to perform well in a wide variety of tests. Note that there is generally a slight gap (less than 1/8 inch) between the edge of the film and the glazing channel to allow for proper installation and removal of excess film adhesive.

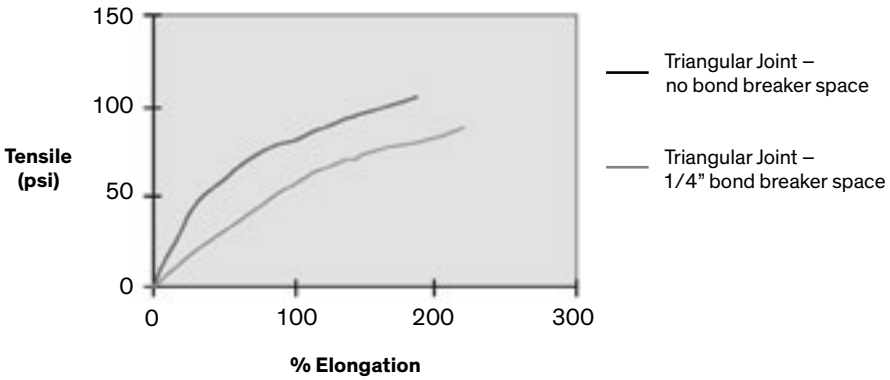
B: **Gasket or glazing channel interior thickness**. This is the distance between the inside of the glass to the framing member. This distance is approximately 1/4 inch, depending upon the type of glazing system. This space could contain material, such as a structural silicone sealant or a firmly anchored gasket, to which DOWSIL™ 995 Silicone Structural Adhesive will adhere. Or this space could contain a material such as a backer rod with little strength or a gasket such as Santoprene to which DOWSIL™ 995 Silicone Structural Adhesive will not adhere. In general, the larger the distance between the glass and the first secure surface with sealant adhesion, the greater the joint flexibility and the lower the joint ultimate strength. (See Figure 3.)

C: **Sealant bite onto the framing member.** To ensure sealant application and adhesion, a minimum sealant bite of 1/4 inch is required for any sealant cap beading application. Some high-performance applications designed to withstand an applied force (blast resistance, hurricane resistance, etc.) are built around a sealant bite of up to 1/2 inch.

A gap between the window and the mullion creates a more flexible but a slightly weaker joint. The performance of two DOWSIL™ 995 Silicone Structural Adhesive joints (dimensions A and C = 1/2 inch for each joint), one with a gap of 0.0 inch and the second with a gap of 1/4 inch, pulled to failure at a rate of two inches per minute, is documented in Figure 3.

Because the requirements for any application are specific to that application, it is critical to ensure that the system to be installed has been tested as a whole. Generally, increasing flexibility improves performance, and increasing strength improves performance. But a tradeoff exists between strength and flexibility that must be considered by the system designer.

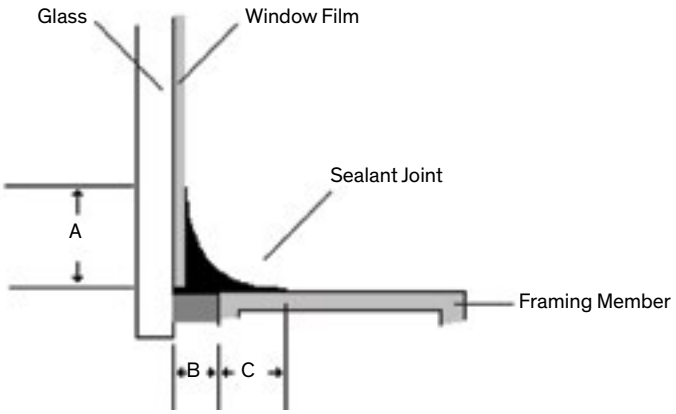
Figure 3. Window-mullion gap and joint strength



Potential areas of concern

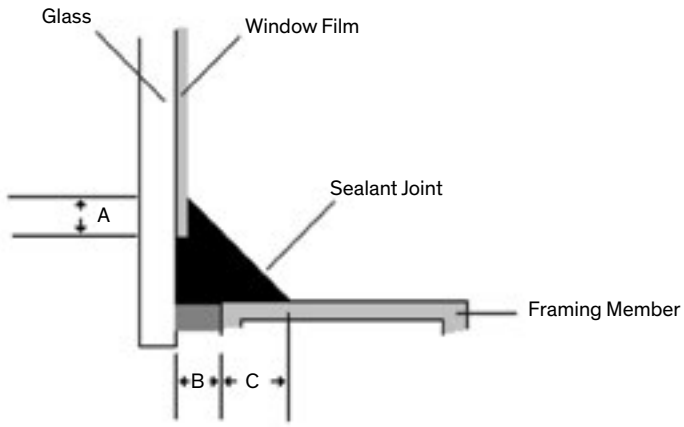
There are several areas of concern related to the way a triangular joint could be applied that can result in reduced performance. **These practices should be avoided.**

Figure 4. Concave joint surface **(Unacceptable)**



In this joint, the sealant is tooled to produce a concave surface that would affect the strength and performance of the joint. The greater the joint concavity, the weaker the joint.

Figure 5. Film too short of edge of daylight opening **(Unacceptable)**



In this illustration, the window film is left too far back from the edge of the daylight opening. The sealant contact with the film is much less than required for the system design, and joint performance will be reduced accordingly.

Figure 6. Silicone structural adhesive applied over an existing internal gasket without any cutback, resulting in a reduction of sealant bond to the framing member **(Unacceptable)**

In this example, the sealant adhesion onto the frame (dimension C) is inadequate for the bond required for an acceptable sealant joint. If the sealant bonds to the gasket, the bond is actually to a thin flap of rubber that is not designed to carry a load. As a result, the joint performance will be greatly reduced.

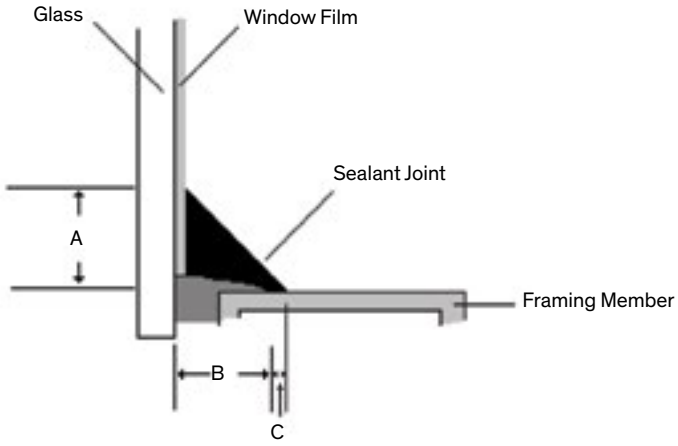
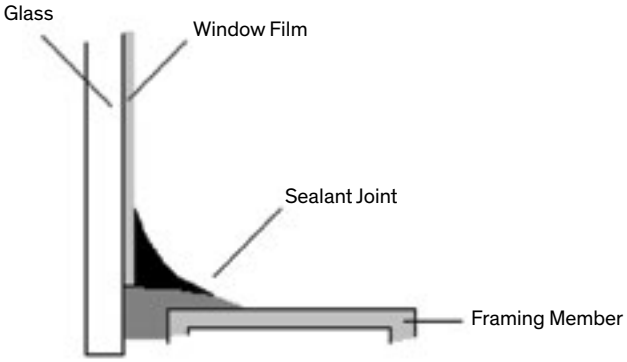


Figure 7. Do not seal directly to a gasket, and do not tool concave **(Unacceptable)**



In this application, the sealant contacts only an existing gasket and not the framing member. This is clearly unacceptable because (1) sealants often do not adhere to gasket material and (2) the gasket may not be designed to support a load. Also, as noted in Figure 4, concave joints are weaker than triangular joints.

Conclusion

This information is provided as a general guideline and is not a cookbook for designing joints for high-performance protective window systems. The glazing sealant is only one component of the system, and system designers must evaluate the entire system, including the film and window frames.

Dow is not in a position to make claims about all protective window systems or those of specific system manufacturers. However, if you have sealant-specific questions, please find local contact information at **consumer.dow.com/contactus**.

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