

Tremco® Structural Silicone Glazing

Section 3 – Protective Glazing

Protective glazing includes systems designed to resist impact/hurricane, bomb blast, ballistic attacks and forced entry. Protection against these man-made and natural disasters is a key concern for today's owners, specifiers, architects, contractors, consultants, and engineers.

Tremco's Structural Silicones bond glass to a curtainwall's structural framing members, transferring dynamic wind loads and impact from the glass through the structural silicone sealant to the curtainwall framing. These structural silicone sealants, which have been tested with major curtainwall and window manufacturers in North America, provide the excellent adhesion, tensile strength and flexibility critical for withstanding wind cycle loads and missile impacts. The industry's most stringent performance standards have been either met or exceeded for hurricane, impact and blast resistance.



Tremco® Spectrem 2 and Proglaze® II silicone sealants have been tested and approved for impact glazing using shock tube testing as well as other test methods utilized in protective glazing.

A silicone sealant is only one component of a glazing system. A glazing system that meets the testing and code requirements for high-performance impact glazing must successfully integrate the frame and its anchorage, glass, or other glazing materials, protective film or interlayer and silicone sealant into a high performance system. Compliance with code or other requirements can be determined through physical testing of the glazing system or through computer simulation. Tremco products for protective glazing include structural silicones, custom gaskets, shims, setting blocks and structural glazing tapes.

The following Tremco products have successfully passed various industry test methods for use in protective glazing:

- **Spectrem 2 and Proglaze II Structural Silicones**
- **SGT-900 Series Structural Glazing Tape**
- **Custom Glazing Extrusions (gaskets, shims, setting blocks)**

As a leader in the Commercial Glazing Market, Tremco has recently developed a Blast Resistant and Protective Glazing Program which parallels efforts with Tremco's Impact/Hurricane-Resistant Program. Tremco's Impact/Hurricane-Resistant Program has been very successful providing major curtainwall and window manufacturers with high performance Structural Silicone Sealants, High Performance Glazing Tapes and Compatible Gaskets to successfully pass the most stringent impact standards.

Aspects of our Blast Resistant and Protective Glazing Program are as follows:

- Tremco is a member of the Protective Glazing Council.
- Tremco is a member of the AAMA Blast Mitigation, Ballistic-Resistance and Blast Task Group:
 - The scope of this group is to report the status of developing a specification/rating system using existing protocol for blast resistant systems. This Task Group is also working towards the development of a certification program, which will include analytical programs.
 - This extensive document is on a fast track, and the first draft will include a 'guide spec' and a project specific 'certificate'. AAMA has teamed with National Institute of Building Sciences for their influence in the development of this spec. Other committees involved in creating this are CSI, AIA, GSA, DOD, PGC, and APG. All the GSA performance criteria (the 1 through 5 rating system) will be incorporated into this spec and may become a joint document with the PGC. GSA specs are available at www.oca.gsa.gov. Structural silicones play an important part in these 'blast' designs for protective glazing. ASTM is also developing a Protective Glazing spec.
- Tremco is a voting member on the ASTM Performance Glazing Committee.
- Tremco has collected data on High Speed Elongation and Tensile Strength testing on our Structural Silicone Sealants that are approved for blast applications. This data can be used in Finite Element Analysis.
- Tremco has tested its Structural Sealants in Shock Tube Tests, per GSA standards (GSA Performance Condition Levels can be found in this section), with different film manufacturers along with several laminates with a PVB interlayer yielding great success.
- Tremco is currently partnered with a blast consultant to apply Finite Element Analysis software for blast applications as well as risk assessments and drawing review.

Further information about Protective Glazing requirements can be found on the chart, titled “Building codes, standards and other organizations evaluating performance of Glazing systems”. Use these websites to obtain the latest regulations in Protective Glazing.

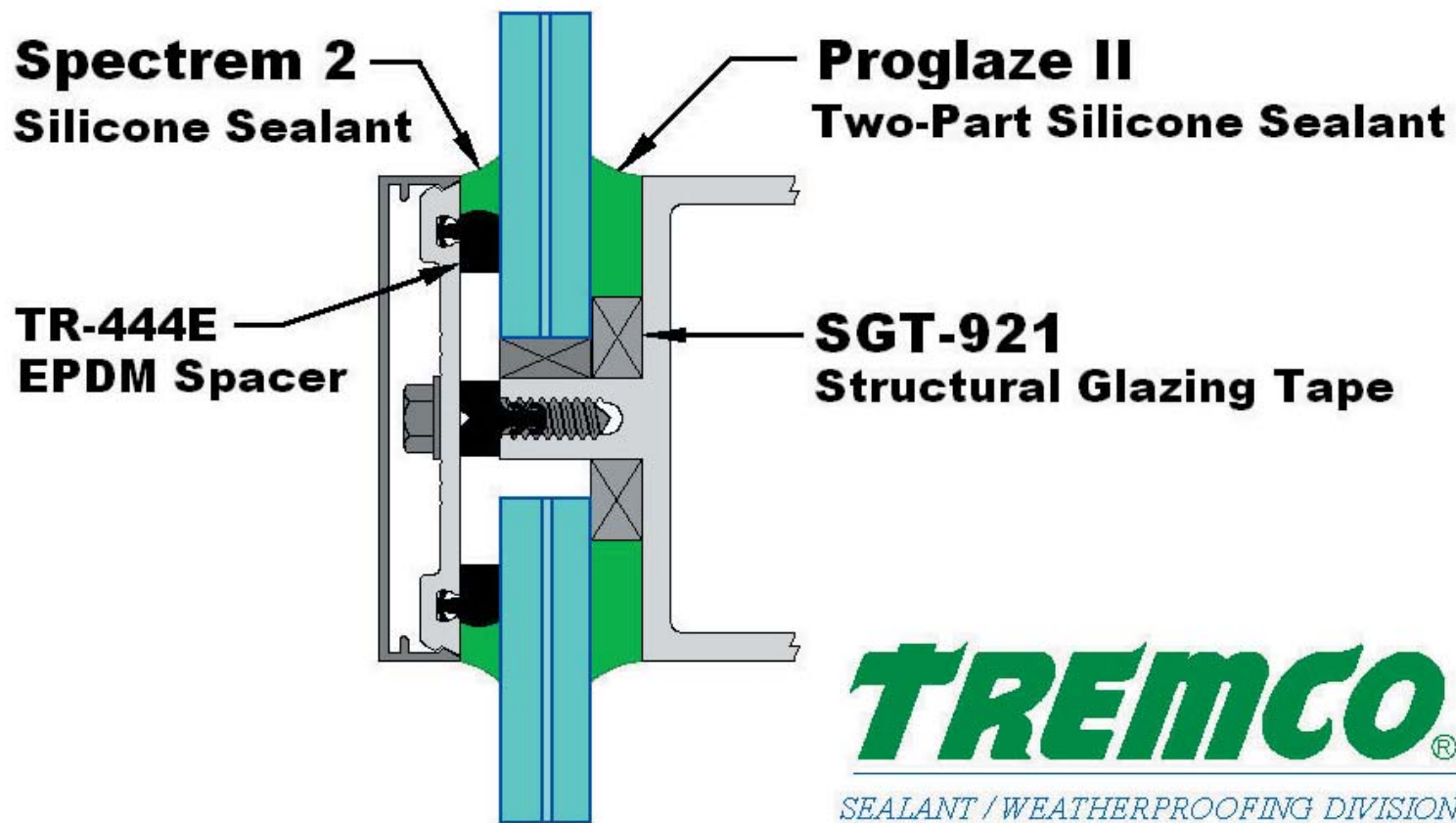
Also attached is a recent cover article on Protective Glazing which appeared in the April 2004 issue of *US Glass Magazine*. This article discusses the importance of the entire glazing system and offers tips on how to avoid the risk of failure during mockup testing.

Following the article is a common factory glazed detail used in protective glazing. A case study utilizing Proglaze II and Spectrem 2 in a protective glazing retrofit is found at the end of this section.



Tremco Proglaze® II (left) and Spectrem® 2 (right) structural silicones continue to bond the glass in place after shock tube testing thus approving these silicones for protective glazing with this system.

Typical Protective Glazing Detail





Tremco Inc. Structural Silicone Glazing

GSA (US General Services Administration)/ISC (Interagency Security Committee) Performance Conditions for Window System Response

Performance Condition	Protection Level	Hazard Level	Description of Window Glazing Response
1	Safe	None	Glazing does not break. No visible damage to glazing or frame.
2	Very High	None	Glazing cracks but is retained by the frame. Dusting or very small fragments near sill or on floor acceptable.
3a	High	Very Low	Glazing cracks. Fragments enter space and land on floor no further than 3.3 ft. from the window.
3b	High	Low	Glazing cracks. Fragments enter space and land on floor no further than 10 ft. from the window.
4	Medium	Medium	Glazing cracks. Fragments enter space and land on floor and impact a vertical witness panel at a distance of no more than 10 ft. from the window at a height no greater than 2 ft. above the floor.
5	Low	High	Glazing cracks and window system fails catastrophically. Fragments enter space impacting a vertical witness panel at a distance of no more than 10 ft. from the window at a height greater than 2 ft. above the floor.

Section Three

Building codes, standards and other organizations evaluating performance of glazing systems

South Florida Building Code (SFBC) www.miamidade.gov/buildingcode/	The first building code in the United States to mandate windborne debris protection for all new construction (1993).
Southern Building Code Congress International (SBCCI) www.sbcci.org	Test standard for determining impact resistance from wind-borne debris. (SSTD 12)
Miami-Dade County Building Code Compliance Office (BCCO) www.co.miami-dade.fl.us/buildingcode	Stringent building codes in South Florida.
American Society for Testing and Materials (ASTM) www.astm.org	First national consensus references for wind-borne debris protection: E-1886 sets the test method; E-1996 provides a specification for determining the performance of exterior windows, curtainwalls, doors and storm shutters impacted by debris and air pressure found in windstorm environments.
American Architectural Manufacturers Association (AAMA) www.aamanet.org	ASTM documents serve as the basis for AAMA's standards on wind-borne debris protection.
International Code Council www.iccsafe.org	Standard combining SBCCI, BOCA and ICBO. Has missile-impact requirements using ASCE 7 and requiring impact protection within one mile of the Gulf and Atlantic Coasts and in South Florida (with some exceptions).
American Society of Civil Engineers (ASCE) www.asce.org	ASCE 7 requires that buildings in hurricane-prone areas be designed so the openings are protected or the structure shall be designed as partially enclosed.
Texas Department of Insurance www.tdi.state.tx.us	A wind-borne debris standard applying to new construction in 14 Texas communities within 25 miles of the Gulf of Mexico.
General Services Administration (GSA) www.gsa.gov	A system of performance-based criteria to measure the security level desired and glazing requirements in all Federal buildings.
Department of State (DOS) www.state.gov	Not published.
Department of Defense (DOD) www.defenselink.mil	Unified Facilities Criteria (UFC).
Glass Association of North America (GANA) www.glasswebsite.com	GANA technical committees develop voluntary standards, product specifications and training, working cooperatively with other industry groups.
Protective Glazing Council (PGC) www.protectiveglazing.org	PGC represents manufacturers of protective glazing products and systems, suppliers to these manufacturers, consultants and testing organizations and provides support to government and industry in the development of standards and specifications.
Protecting People First Foundation www.protectingpeople.org	A nonprofit organization working to raise awareness of the hazards associated with terrorism, manmade and natural disasters and to promote steps that can be taken to protect buildings and occupants.
Factory Mutual www.fmglobal.com	Insurance evaluation service involving mainly commercial structures.