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Commercial Sealants & Waterproofing

The Advantages of Proglaze® ETA
Pre-Engineered Air Barrier Transition Window-Wall Interface Assembly

By: Kevin D. Knight, Bryan J. Boyle
Retro-Specs Consultants Ltd.

Published 9/2008

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Executive Summary

The building envelope is the 'outer shell' of the building, designed and constructed to provide separation between the interior building environment and the exterior environment. To fulfill this purpose, the building envelope must satisfy four key requirements: an air barrier to control the movement of air across the building envelope, a thermal barrier to provide insulating properties, drainage planes to effectively manage water infiltration, and a vapor barrier or retarder to manage the diffusion of vapor through the building envelope. While it is important that each component intended to provide these functions does so effectively, it is equally important that no 'gaps' exist in the system as a whole as performance between the individual components/assemblies often determines the overall effectiveness of the system.

Functional performance at the window-wall interface often has a significant effect on overall building envelope system performance. While building envelope materials, design and construction have exhibited a number of improvements in recent years, the window-wall interface continues to be a problem. Compromises in building envelope performance at the window-wall interface can frequently be attributed to design, materials, workmanship and sequencing, or a combination of these elements. Compounding the above issues is that where the window-to-wall interface tie-in is located mid-wall, it is imperative that the detail be designed and constructed correctly prior to being covered as rectification can be expensive, time-consuming and impractical.

Proglaze® ETA, manufactured by Tremco Commercial Sealants & Waterproofing ("Tremco"), is a pre-engineered air barrier transition assembly, mechanically attached to the window and/or curtain wall structural framing, used to bridge continuously between the window/curtain wall opening and the adjacent air and vapor protection materials and ensure a durable connection and seal. It is comprised of a Silicone Rubber Extrusion with lock-in dart, pre-molded Silicone Rubber Corners with a lock-in dart offset 1.5" , an alodine-finished Extruded Aluminum Adaptor with a pre-engineered race for receiving the silicone lock-in dart, Tremco 440™ polyisobutylene cross-linked butyl performance tape, and single-component Spectrem® 1 Silicone Sealant, all formulated to work together within the assembly and in conjunction with the manufacturer's adjoining components and systems to ensure long-term compatibility and performance. Proglaze ETA may be shop- or field-installed, depending upon the system's sequence of installation for the particular window or curtain wall assembly.

In reviewing the product itself, laboratory test results, and on-site applications, several benefits gained by utilizing Proglaze ETA as the window-to-wall interface transition became apparent:

- Proglaze ETA exhibits the key characteristics of an effective air barrier system.
- Proglaze ETA has a very low vapor permeance and exhibits the characteristics of an effective vapor retarder.
- Several aspects of the Proglaze ETA assembly lead to a reduction in installation deficiencies, resulting in increased life cycle durability.
- Proglaze ETA is water-resistant, and acts as an effective drainage plane at the window-wall interface.
- Proglaze ETA is a pre-manufactured 'single-source' assembly, where all of the components comprising the assembly have been formulated and tested for complete compatibility within the assembly in conjunction with the manufacturer's adjoining components and systems. This single-source characteristic also leads to the elimination of potential delays in waiting for completion of tie-ins, reduces or eliminates the costs of multiple trips to complete tie-in details, and eliminates many of the workmanship errors common at the tie-in resulting from multiple trade involvement.
- Incidental damage to the Silicone Rubber Extrusion and Silicone Rubber Corners during construction can be easily seen and repaired.

Tremco has also developed modified versions of the Proglaze ETA Assembly to deal with different design and on-site conditions, and different types of curtain wall systems. The Proglaze ETA Offset Dart Design System can be used where the window is 'offset' and is not installed flush to the fenestration opening. The Proglaze ETA Pressure Bar System can be used on curtain wall systems where the connection point for the air barrier onto the curtain wall frame is onto the throat of the curtain wall to the unglazed pocket instead of to the inner part of the curtain wall extrusion.

There appears to be numerous additional applications which Proglaze ETA and its inherent technology, given proper modification, could be utilized. The nature of problems that occur at the window-wall interface are often typical to other locations throughout the building, such as junctions between other assemblies within the building envelope where spanning of voids is commonplace, areas or locations where a degree of movement is anticipated, and other openings or penetrations through the functional layers of the building envelope system.

Introduction

The building envelope is the 'outer shell' of the building, comprising all of the components of the exterior; above grade and below grade walls, roofs, and basement floor, that are designed and constructed to provide separation between the interior building environment, which is controllable, and the exterior environment, which is not controllable. To fulfill this purpose, the building envelope must satisfy four key requirements: an air barrier to control the movement of air across the building envelope, a thermal barrier to provide insulating properties, drainage planes to effectively manage water infiltration, and a vapor barrier or retarder to manage the diffusion of vapor through the building envelope.

There are many commercial air barrier materials whose air permeance is less than the maximum 0.004 cfm/ft^2 @ 1.57 psf recommended to provide the principal resistance to air leakage[1], commercial vapor barrier materials whose vapor permeance characteristic meets the most stringent requirements, insulation materials offering high R-values, and flashing materials offering effective drainage. Most windows and curtain wall systems are designed and constructed to meet or exceed exterior wall performance requirements for most regions. Despite this, building envelope repair and replacement cost in North America remains a multi-billion dollar expenditure, where the premature failure rate is conservatively estimated at between 3 and 5 percent[2]. It is difficult to determine what percentage of building envelope failure can be attributed to a failure to perform each of the specific required functions, but inadequate management of air and moisture infiltration is a primary factor. One study determined that over half of the building set examined experienced building envelope problems within the initial years of occupancy, and that most of the problems were moisture related and caused either by air leakage or exterior moisture penetration[3].

While it is important that each component within the building envelope system perform its intended function within the system framework, it is equally important that no 'gaps' exist in the system as a whole; that is, the required functions of the building envelope must be performed at the connection between the individual components/assemblies as performance at these junctions usually determines overall effectiveness of the system[4]. For example, as much as 90% of all water intrusion problems may occur within the one percent of the total building exterior surface area which contains the terminations and transition detailing[5]. And while building envelope materials, design and construction have exhibited a number of improvements in recent years, the window-wall interface continues to be a problem – a concern given that the air leakage performance of the window-wall interface has a significant effect on the air leakage performance of the entire window unit as installed[6].

In this white paper, we will review Proglaze® ETA, manufactured by Tremco Commercial Sealants & Waterproofing ("Tremco"), a pre-engineered air barrier transition assembly designed for bridging continuously between the window and/or curtain wall opening and the adjacent air barrier materials, and to address and eliminate many of the problems experienced at the window-wall interface. A description of the product and independent laboratory test results will be provided, and a short case study presented. To begin, common issues at the window-wall interface that compromise the integrity of the building envelope system, the results stemming from system failures, and reasons why these problems occur, will be discussed.

Audience

The document is intended for a technical audience of building designers, architects, engineers, construction specifiers, constructors, owners, and commissioning, inspection and testing agents interested in window-wall interface science and technology in commercial, residential, medical, industrial, institutional, and other high-performance buildings. This document assumes that the reader has basic knowledge of building science, commercial and residential building materials, and building design and construction terminology.

The Window-Wall Interface

Placement of Functional Components

In cold or severely cold climates where the building's interior space is conditioned, the vapor barrier should be designed and installed on the warm (or 'high-vapor') side of the wall, at a sufficient depth to ensure that dew point temperature occurs to its exterior side. The air barrier may be placed anywhere within the wall provided it prevents warm conditioned air from coming in contact with cool surfaces where temperature is below dew point. If the air barrier is designed and installed outboard of the thermal plane, the air barrier material's vapor permeance should be such that (or the system be designed such that) water vapor will diffuse to the exterior of the building envelope, or a vapor retarder of lesser permeance is used on the inside. Where a material is to act both as an air barrier and vapor barrier, it should be designed and installed on the warm (or 'high-vapor') side of construction, at a sufficient depth to ensure dew point temperature occurs to its exterior side[7].

In warm climates, the 'science' behind the placement of components does not change. The vapor barrier will still be placed on the warm side of the wall. However, because the warm side of the wall will be closer to the exterior than in cold climate construction, the vapor barrier will be placed closer to the exterior as well. In other words, the placement of vapor and thermal protection will always be relative to each other[8].

There are two distinct wall types, face-sealed and cavity wall. *Face-sealed* usually refers to the use of solid walls at the face of the building to keep water out of the structure. The façade materials must be able to shed water effectively such that water absorbed into the face of the material can dry quickly. There is no margin for error or deterioration of the outer face of this system; 100% drainage efficiency is required to keep this wall system functional. In *Cavity wall* construction, on the other hand, exterior finishing materials act as a primary drainage plane, but are designed with a degree of redundancy with some water penetration expected. Inboard of that layer, the air barrier membrane may act as the non-redundant drainage plane, or the last line of defense against water infiltration. If the plane of the air barrier membrane is joined into the window frame outboard of the integral drainage plane of the window unit, infiltrating water may drain behind the last line of defense in the opaque wall.

Common Problems at the Window-Wall Interface

The building envelope system performs four key functions: control of air movement, thermal protection, water management, and control of vapor diffusion. Generally, the wall and window assemblies each perform these functions, and ideally, the functional layers of each adjoining assemblies are placed along the same plane. Consider the diagrams in Figure 1 below. The circles represent the functional components of the building envelope (air barrier, vapor protection, thermal barrier, drainage plane) as installed in a window unit and adjacent wall in a cold exterior climate. The lines connecting the circles represent the connecting of these functions at the window-wall interface. In the upper diagram, the functional plane of each of the four components is consistent at both the window and wall and the performance of the components is not compromised. In the lower diagram, there is a misalignment of some of the functional components between the window and wall. In other words, the components are not installed along the correct planes relative to each other. Problems generally occur when one or more of the functional layers are on a different plane from the corresponding function of the adjoining assembly, with the point of failure occurring at the intersection of the opposing functions. In the real world, this is commonly located at the interface between assemblies.

Inadequate control of airflow through the building envelope is a primary factor contributing to premature building envelope failure. Dominant leakage paths of concern are associated with the window-wall interface. Moisture-laden air permitted to travel through the building envelope may condense under certain conditions, resulting in corrosion or damage to building envelope components, increased heating and cooling loads sometimes in excess of 40% [9,10,11,12] and occupant health and comfort issues, including the stimulation of mold growth. The structural integrity of the air barrier system may be compromised if certain tie-in materials span excessive gaps common at the interface location, or where the bearing surface on the window is insufficient for the tie-in material to adhere, resulting in de-bonding or bellowing out of the tie-in material at the interface or a displacement of insulation.

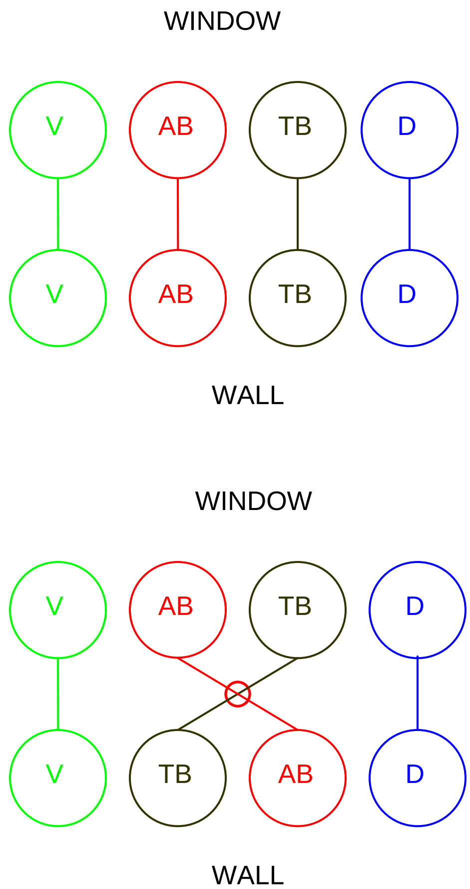


Figure 1. The upper diagram represents a situation where each window function is placed along the same plane as the corresponding wall function. In the lower diagram, the air barrier and thermal barrier functions for the window and wall are no longer along the same functional plane. The compromise in the system occurs where the misaligned functions intersect.

AB: AIR BARRIER
V: VAPOR PROTECTION
TB: THERMAL BARRIER
D: DRAINAGE

Windows are normally designed with thermal performance in mind. As a general rule, the opaque wall air/vapor barrier membrane is installed along the same plane as the glazing within the window unit. The point of connection between the air/vapor barrier membrane and the frame defines the location of the interior and exterior environments. Problems surface when the air/vapor barrier membrane is joined onto the window frame in a position that places the thermal performance of the window inboard or outboard from where its primary function for thermal separation should be located. In the lower diagram in Figure 1, as the plane of airtightness is inboard of the window's thermal plane, the result may be a cooling of the window inboard of the window's thermal plane.

Why Problems Occur at the Window-Wall Interface

Compromises in building envelope performance at the window-wall interface can frequently be attributed to design, materials, workmanship and sequencing, or a combination of these elements. Flaws in any of these elements can have negative ramifications on the ability of the completed system to perform to specification in the short and/or long run.

Design

Window-wall interface details are usually drawn with the line representing the air barrier/vapor protection/drainage plane joined onto a point on the window frame. Additional detail about how the connection will be constructed in the field is seldom provided (Figure 2). Although design must show clear intent for the placement of the performance layers, the designer has limited ability to know the finite details of how assemblies will be joined due to the selection of multi-choice materials during the bid process. The designer is not usually privy to the final selection of materials until after the bid process, and this is subject to variation from the base design.

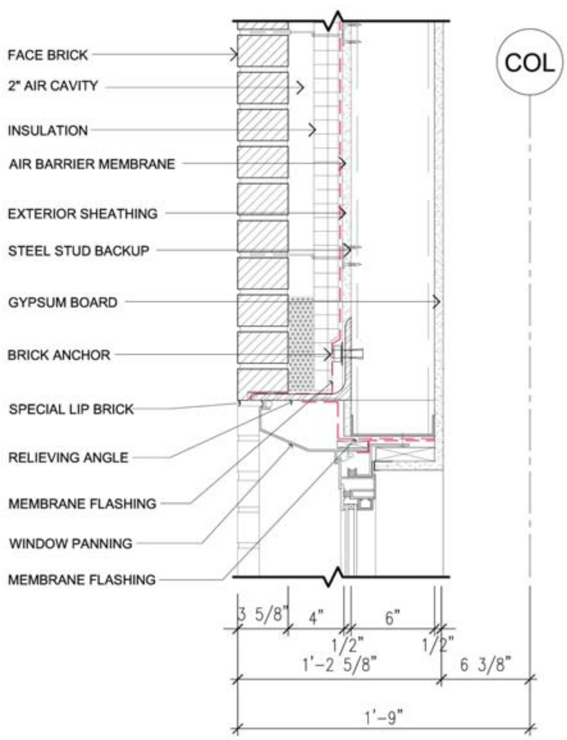


Figure 2. Typical exterior wall detail. Air barrier membrane (red dotted line) is drawn joining onto the window frame, but no corresponding detail showing how the window-wall tie-in is to be constructed is provided.

Compounding this situation is that project details may not take into consideration existing in-situ difficulties[13]. While several 'typical' details for the window-wall interface may be provided, existing site conditions throughout the building may not be 'typical'. There may be a multitude of existing site conditions which might require numerous additional drawn details which, in practice, are not feasible to produce given budgetary and time constraints and limitations of BIM (Building Information Modeling) in junction detailing.

Workmanship

The window-wall interface detail can be one of the most complicated to construct, especially when using conventional air barrier sheet membrane materials, where it is akin to performing an origami exercise using sticky material. Detailing with these materials is skill-intensive - often requiring corner gusset cuts, folding, correct shingling, and affixing of dissimilar materials - and requires ample experience (Figure 3).

Figure 3. Commonly found deficiencies at window-wall interface. Top photo shows reverse-shingling of building paper and membrane wrap. Bottom photo shows PVC flange not secured flush to the wall and membrane wrap poorly detailed and not fully adhered to the wall air/vapor barrier membrane.

As ownership of the interface detail is often poorly defined, there is usually a conflict about who will do the work. Each trade may be responsible for a component or section, but no one trade is responsible for ensuring continuity *between* the individual components or sections. This overlapping trade jurisdiction can lead to many problems during an installation. Where communication between the contractors is poor, the sequencing of construction may be such that the areas of the adjoining assemblies may be inaccessible when the time comes to detail the interface.

Materials

Most materials commonly utilized as a tie-in material at the window-wall interface demonstrate similar characteristics relative to their primary function. For example, commonly used air barrier materials might demonstrate similar air permeance characteristics. However, their other performance characteristics such as adhesion, elongation, puncture-resistance and tensile strength may vary considerably and must be taken into consideration when being specified around wall-window junctions where movement is expected, as the variance may be enough to compromise the ability of the system to function correctly.

Installed materials must not react adversely to other materials or components at the window-wall interface. It is beyond the scope of this paper to document every potential incompatibility that might arise. However, the designer must be aware that incompatibilities can occur, and should carefully consider the physical and chemical properties of the materials being specified. For example, it may be difficult to sufficiently adhere bituminous membranes to some sealants applied to the window frame, or for other materials to adhere to the polyethylene cover on many sheet membrane materials.

Figure 4. Misalignment of the fenestration opening; sill outboard of jamb.

Many of today's commonly utilized transition materials are limited by aspects of their inherent characteristics in their ability to act as the tie-in material in and of themselves at the window-wall interface. Sheet membranes are limited by the width of unsupported gaps that can be spanned to retain structural integrity and durability. Spray foams, when used in conjunction with a drained window system with sill pan flashing, may interfere with drainage planes. Incorrect spraying technique may warp window units, and material overspray may require additional cleaning of affected material or may spoil the finishing materials completely. Flanged windows, where a metal or vinyl flange that can be tied back to the opaque wall is attached to the window, while often effective, are currently limited by availability. They also tend to 'preset' the location of the window into the wall which may conflict with the designer's intended appearance for the exterior façade, and may prove troublesome where there is misalignment with the backup wall at the sill-to-jamb or jamb-to-head (Figure 4). The variety of geometries on buildings, the required width-to-depth ratios of many sealants, and the need for backing materials for support, make using sealants as the transition material an impractical approach. Additionally, most sealants, over the expected life cycle of the building envelope, will be a continual maintenance item, which is an issue if the application is in inaccessible locations. Where the application is exposed, the material may be subject to degradation from UV radiation, and there may be aesthetic issues at large joints.

Non-maintainability

The window-wall interface tie-in must be designed and installed to perform over the expected life cycle of the building envelope. Compounding the above issues is that where the window-wall interface tie-in is located mid-wall, it becomes a non-maintainable item. That is, the detail must be designed and installed correctly prior to being covered as repairs would require disassembly of the wall which can be expensive, time-consuming and impractical.

Current State-of-the-Industry

Over the years, the requirements for environmental separation between interior and exterior environments have increased. This is attributed to several factors; living in locations with extreme climates, the global concern with reducing the consumption of energy and non-renewable resources, and the high costs associated with premature building envelope failure. This has led to numerous advances in building envelope science, design, materials and construction, increasingly stringent code requirements including the general acceptance of air barriers and vapor protection, and the introduction of whole-building envelope commissioning.

Traditionally, windows were installed after the exterior finishing materials had been erected. The window contractor was concerned over the potential for damage to the frame and glass when the finishing materials were installed, while the finishing trade preferred to leave an opening for which the glazing system would be installed rather than working to an installed glazing system. In a worst case type scenario, large precast panel sections could be craned in to be mounted close to a delicate glazing system. But as continuity between the opaque wall and glazing system occurs mid-wall, this sequence of construction had to change to allow for the junction to be successfully constructed, dramatically changing the traditional sequencing of components and requiring advanced planning by the general contractor and relevant trades.

There remains confusion within the political structure of the industry regarding ownership and science of assembly interfaces, a misunderstanding of how adjoining components or assemblies come together as a single system, and how to design and construct interface details so the performance layers of the adjoining components/assemblies are complimentary rather than in conflict.

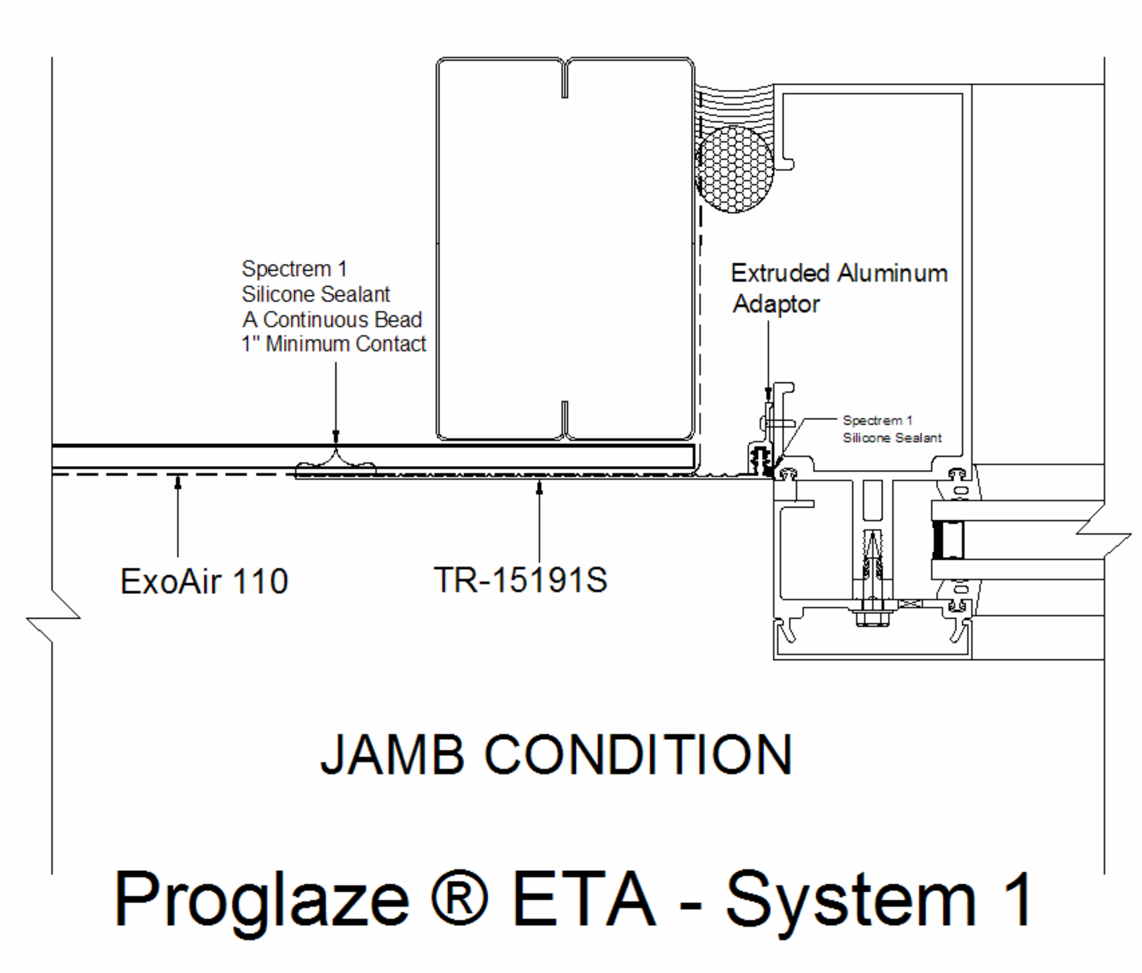
A logical solution to remedy these issues is the development of pre-engineered transition assemblies. The potential benefits are numerous: reduction or elimination of problems currently faced at the window-wall interface; provide the designer with the ability to specify one transition assembly flexible enough to be placed in many different locations and under different climactic conditions, and; providing continuity of performance layers between adjoining components/assemblies in a structurally sound and durable manner.

Proglaze ETA Engineered Transition Assembly

Product Description

Proglaze® ETA is a pre-engineered air barrier transition assembly, mechanically attached to the window and/or curtain wall's structural framing, used for bridging continuously between the window and/or curtain wall opening and the adjacent air and vapor protection materials, and ensuring a durable connection and seal. Proglaze ETA is available in three systems, System 1 - Standard 6" Design, System 2 – Off-Set Dart Design, and System 3 - Pressure Bar System. System 1 - Standard 6" Design is shown in the drawing below (Figure 5).

Figure 5. Proglaze ETA System 1 - Standard 6" Design.



Proglaze ETA is comprised of the following components[14]:

- Silicone Rubber Extrusion, an extruded 40 durometer translucent silicone, with a lock-in dart.

- Silicone Rubber Corners, pre-molded, 40 durometer, translucent silicone with a lock-in dart offset 1.5” to allow a lap joint to be made with the Silicone Rubber Extrusion.

- Extruded Aluminum Adaptor, an alodine-finished aluminum with a pre-engineered race for receiving the silicone lock-in dart. The extrusion is supplied in five-foot lengths with pre-drilled 3/16” diameter holes and pre-applied Tremco 440 Tape on the backside.

- Tremco 440™ Tape, 100% solid Polyisobutylene cross-linked butyl performance sealant used for non-compression glazing of vision lites and spandrel panels, and lap sealing between panels such as steel, aluminum and porcelain. Within the Proglaze ETA assembly, it is used to temporarily hold the metal adaptor in position before mechanical fasteners are installed, and to act as a secondary air and water seal.

- Spectrem® 1 Silicone Sealant, comprised of a single-component, neutral-curing silicone. It is a high-movement ultra-low modulus sealant utilized as a compatible adhesive and wet seal, formulated for expansion joints, control joints, lap joints, and ideal for sealing moving joints including materials with a high coefficient of linear expansion such as aluminum curtain wall and window perimeters.

Installation

Proglaze ETA may be shop- or field-installed, depending upon the system’s sequence of installation for the particular window or curtain wall assembly[15].

Shop Installation

The Extruded Aluminum Adaptor is cut to the approximate length (or combine lengths) to span the length of the window or wall frame. Once the area of the window frame where the Extruded Aluminum Adaptor is to make contact has been cleaned, the release paper on the back of the Adaptor is removed and the Adaptor positioned on the window and/or wall support member and temporarily held in place by the Tremco 440 Tape which comes pre-applied to the backside of the Adaptor. Once the surface of the Adaptor has been cleaned and dried, it should be mechanically affixed to the window and/or wall frame using minimum #10 x ¾” PHT size screws (use of larger screws must be approved by the window and/or wall manufacturer) installed a minimum of every 12”.

Spectrem 1 Silicone Sealant is applied to the Extruded Aluminum Adaptor’s race, and between the Extruded Aluminum Adaptor and window frame. The Silicone Rubber

Extrusion is then inserted into the Adaptor's race. Once inserted, the sealant is further compressed against the Extruded Aluminum Adaptor, window frame and Silicone Rubber Extrusion.

Field Installation

The Extruded Aluminum Adaptor is cut to length to surround the window and/or wall system.

To allow a one-inch minimum overlap under the pre-molded corner, a total of ten inches (five inches on either end of the window unit) is subtracted to determine the length of the Silicone Rubber Extrusion. The molded corner's dart is set back from the edge 1.5" to allow for the overlap.

Spectrem 1 Silicone Sealant is applied to the Extruded Aluminum Adaptor's race. The Spectrem 1 adheres the Silicone Rubber Extrusion to the race while affixing the Extruded Aluminum Adaptor to the wall or window frame. The gasket is then inserted into the race. Spectrem 1 is then used to seal the lap joints, with the perimeter seal completed last to permanently bond the Silicone Rubber Extrusion to the wall air/vapor barrier membrane.

Benefits

1. **Effective air barrier**. Proglaze ETA exhibits the key characteristics of an effective air barrier system (refer to Independent Laboratory Test Results):

   - The system air leakage rate of <0.01 cfm/ft^2 @ 1.57 psf falls below most published references for maximum allowable system air leakage.

   - The system itself is continuous, and provides air barrier continuity between different assemblies.

   - The system can absorb dynamic movement and wind-loading stresses without rupturing and can span and seal across irregular window geometries while meeting performance requirements.

   - It is resistant to the mechanisms of deterioration that it can be reasonably expected to be exposed to given the nature, function and exposure of the materials.

2. **Vapor permeance.** Proglaze ETA has a very low vapor permeance[1] and exhibits the characteristics of an effective vapor retarder[2].

[1] 2.59 perms when tested in general accordance with ASTM E 96 (dry cup method).

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3. **Increased life cycle durability.** Several aspects of the Proglaze ETA assembly lead to a reduction in installation deficiencies, resulting in increased life cycle durability, specifically:

   - As the assembly is pre-manufactured, it eliminates complex and skill-intensive detailing at common 'trouble areas' within the window-wall interface, such as corner locations.

   - There is generally a lesser lineal distance of seams and joints as compared to traditional tie-in methods using simply sheet membrane materials, reducing the area of potential air and water infiltration locations.

   - The translucency of the silicone materials allows for easy observation through the gasket to view the application of the Spectrem 1 Sealant to verify the integrity of the seal.

4. **Effective water barrier and drainage plane.** Proglaze ETA is water-resistant, and acts as an effective drainage plane at the window-wall interface (refer to Independent Laboratory Test Results).

5. **Single-source accountability.** Proglaze ETA is a pre-manufactured 'single-source' assembly. As such, all of the components comprising the assembly have been formulated and tested for complete compatibility. Its components have also been formulated and tested when used in conjunction with the manufacturer's adjoining components and systems -- self-adhered air and vapor barrier membranes, self-adhered thru-wall flashing membranes, and sealants, setting blocks, gaskets and glazing tapes -- to ensure long-term compatibility and performance. The advantage of a single source for these adjoining systems is that the systems have been formulated to go together.

   As the assembly is a pre-manufactured single-source assembly, this eliminates potential delays in waiting for completion of tie-ins, reduces or eliminates the costs of multiple trips to complete tie-in details, and eliminates applicator variations and many of the workmanship errors common at the tie-in resulting from multiple trade involvement.

6. **Ease of repair.** Incidental damage to the Silicone Rubber Extrusion and Silicone Rubber Corners during construction can be easily seen and repaired. Applying a generous bead of Spectrem 1 Sealant over the penetration is generally sufficient to seal the penetration. Some tears can also be repaired by affixing a length of the Silicone Rubber Extrusion over the tear with Spectrem 1 Sealant where the materials overlap.

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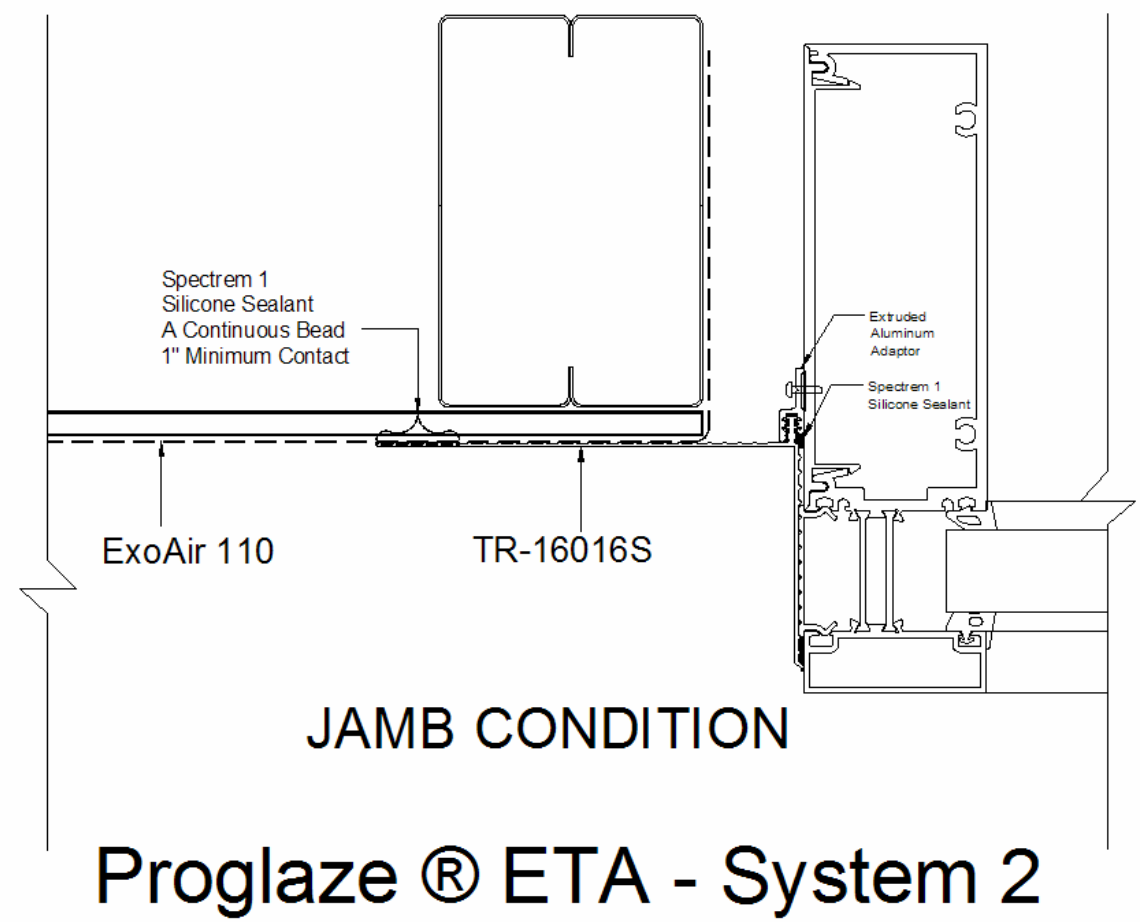
[2] In most North American jurisdictions, vapor retarder is defined as having a vapor permeance characteristic between 1 and 10 perms.

System 2 – Off-Set Dart Design

There is a high-degree of difficulty inherent in constructing the window-wall interface tie-in if the window is 'off-set' and is not installed flush to the fenestration opening. This detail often requires additional inside and outside corner gusseting for the membrane to be effectively tied in from the frame to the opaque wall. As such, certain window and/or wall systems may require a new off-set dart design with offset molded corner, custom shapes or modifications to the Silicone Rubber Extrusion or Silicone Rubber Corners to perform as required; this would typically include expansion joints, extended lap/splice/bridge joints, head receptor, and inside/outside corner conditions. Tremco design engineers can work to modify components and customize solutions appropriate for the site conditions, custom-designing the assembly to fit any offset profile in the glazing system to the opaque wall. (Figure 6).

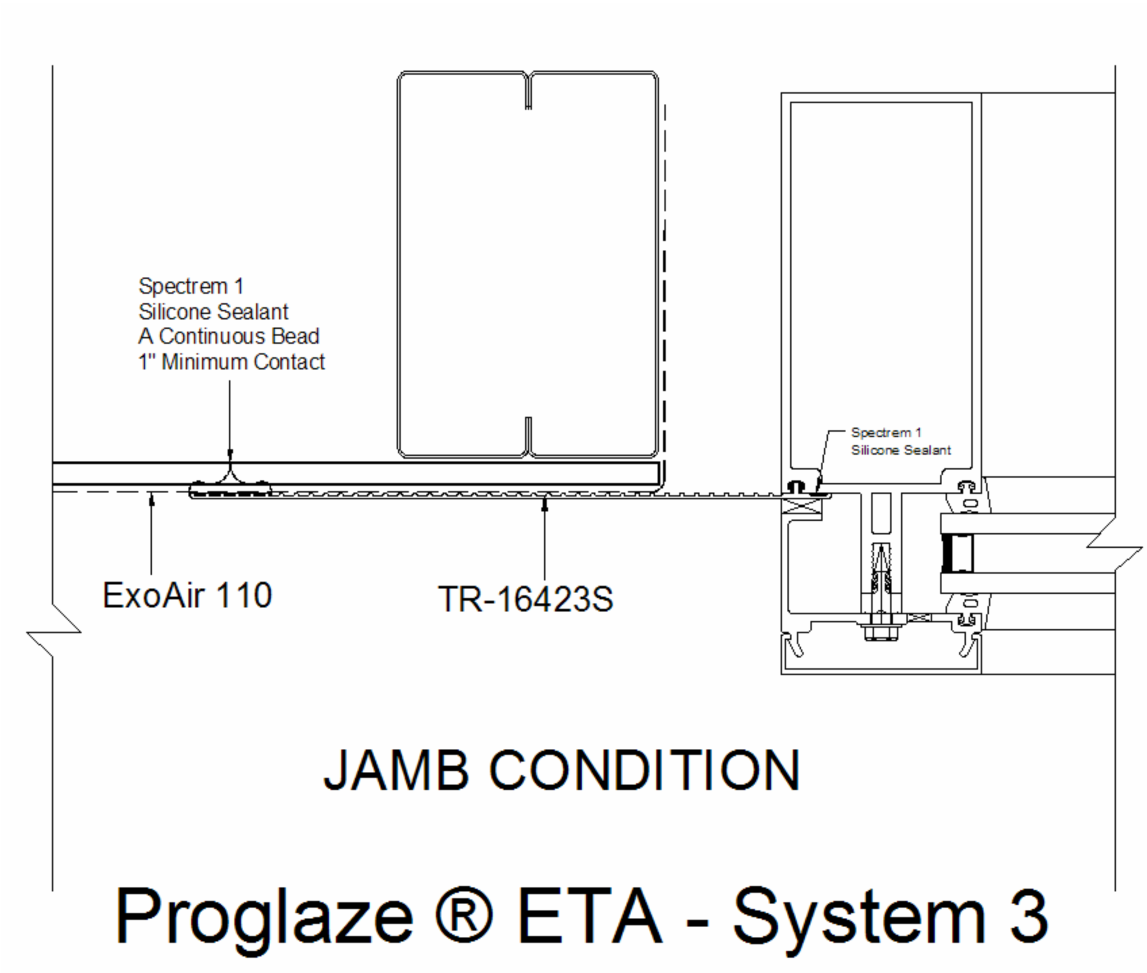
Figure 6. Proglaze ETA System 2 – Off-Set Dart Design.



System 3 - Pressure Bar System

Typical of most curtain wall systems, the correct connection point for the air barrier onto the curtain wall frame is onto the throat of the curtain wall to the unglazed pocket. If the air barrier is connected to the inner part of the curtain wall extrusion, there is the potential for breaching the air seal at the junction of the vertical and horizontal members. For these systems, Tremco developed System 3 - Pressure Bar System, where a Silicone Rubber Extrusion with lock-in dart fits into the curtain wall race and is sealed in place with Spectrem 1 Silicone Sealant. It is then clamped in place by the pocket filler and pressure plate (Figure 7). The assembled system is set into the opaque wall air barrier similar to the other Proglaze ETA systems.

Figure 7. System 3 - Pressure Bar System.



Independent Laboratory Test Results

The Proglaze ETA assembly has undergone independent laboratory testing for air infiltration, water resistance, and structural performance. Additionally, the Silicone Rubber Extrusion underwent laboratory testing for vapor permeance. Testing of the samples was performed under the following test protocols:

1. *Air infiltration* was tested to ASTM E 283 "Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

2. *Water resistance* was tested to ASTM E 547 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference, and ASTM E 331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

3. *Structural performance* was tested to ASTM E 330 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

4. *Vapor permeance* of the Silicone Rubber Extrusion was tested to ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials (dry cup method).

Test results are summarized in Figure 8 below[16,17].

TITLE OF TEST	TEST METHOD	RESULT
Water Vapor Transmission	ASTM E 96 (Dry Cup Method)	2.59 perms
Air Infiltration 75 Pa (1.57 psf) 300 Pa (6.24 psf)	ASTM E 283	<0.05 L/s/m^2 (<0.01 cfm/ft^2) <0.05 L/s/m^2 (<0.01 cfm/ft^2)
Water Resistance 718 Pa (15.0 psf)	ASTM E547 ASTM E 331	No leakage
Uniform Load Deflection ± 6699 Pa (± 140.0 psf)	ASTM E 330	No damage
Uniform Load Structural ± 10,049 Pa (± 210.0 psf)	ASTM E 330	No damage

Figure 8. Independent laboratory test results.

Case Study: Children's Hospital of Wisconsin, West Tower Expansion

Supplied by Tremco Commercial Sealants & Waterproofing in conjunction with Children's Hospital Wisconsin, Oscar J. Boldt Construction and Shepley Bulfinch Richardson & Abbott.

In 2006, plans commenced for the construction of a 12-story, 425,000-square-foot expansion tower at the Children's Hospital of Wisconsin. The new tower would add 58 more beds, with future potential to add an additional 72 beds, and would also include a larger pediatric intensive care unit and an expanded Herma Heart Center[18].

Given the high-performance requirements of the structure, and the Owner's requirement that the building last between 50 and 100 years, it was imperative that the exterior façade be designed and constructed to prevent the uncontrolled ingress of moisture or the formation of condensation within the building envelope, as the consequences of systemic building envelope failure could be disastrous.

The final design incorporated a curtain wall system with six-story spans along the projections and recessions in the wall. One of the primary concerns was maintaining continuity between the dissimilar materials of the curtain wall system and adjoining wall system - a critical junction where control of air and moisture infiltration must be maintained - where dynamic movement would be expected and where multiple installers would typically be involved in the construction process. To accomplish this required that the building envelope system incorporate a durable solution – preferably single-source to ensure accountability - that provided flexibility at the curtain wall-precast interface capable of withstanding the loads expected to be placed against it over the course of the expected life cycle, and provide increased flexibility of design allowing greater movement and deflection under varying geometries.

To meet the above demands, Proglaze ETA Engineered Transition Assembly was selected to provide the tie-in between the curtain wall system and adjacent wall assemblies. Proglaze ETA had several characteristics that were of significant benefit on this project, and eliminated several factors that contribute to potential problems on projects of this magnitude and complexity:

- As the building's design incorporated a variety of geometries resulting in complicated junctions between the window and wall systems, it would have been difficult to construct durable and consistent connections solely using typical sealants. The Proglaze ETA system eliminated the opportunity for applicator variations, and provided an easier installation at troublesome details. The Extruded Aluminum Adaptor was actually installed in the curtain wall manufacturer's shop.

- Use of the Proglaze ETA system allowed for increased efficiency during the construction process. Due to the 'single-source' nature of the Proglaze ETA system, the connections between the curtain wall and adjoining wall assemblies were constructed quicker than may have been the case if the connection was a multi-trade responsibility as varying construction sequencing and potential compatibility concerns between interface components were reduced.

To ensure that Proglaze ETA would meet the design intent as the window-wall interface assembly, a full-scale mockup of the curtain wall and adjacent exterior wall systems was constructed. The mockup was tested by Architectural Testing Inc. at their site in York, PA. Seventeen different tests were conducted, and based upon the test results, it was concluded that the assembly would sufficiently withstand water penetration, thermal changes, and load deflection, and that the measured air leakage rate of the system was below the allowable. Over 40 independent field tests were conducted during the construction process that confirmed the results of the mockup testing, and ensured the ongoing installation was consistent with the benchmark standard established during mockup testing.

Future Applications

The potential applications of Proglaze ETA and its inherent technology should not be limited to the window-wall interface. Certainly this product, given application modification, could be utilized at junctions between other assemblies within the building envelope where spanning of voids is commonplace, such as roof-to-wall, areas such as control joints or expansion joints or any location where a degree of movement is anticipated, and at any opening or penetration such as louvers and mechanical openings.

Conclusion

Given the problems that commonly occur at the window-to-wall interface, there are numerous benefits to utilizing pre-engineered assemblies to maintain continuity of the functional performance requirements of the building envelope. Laboratory and field testing have shown that Proglaze ETA pre-engineered air barrier transition assembly can be used for effectively bridging continuously between the window and/or curtain wall opening and the adjacent air and vapor protection materials to provide a durable connection and seal. With the Off-Set Dart Design and Pressure Bar variations of the system in addition to the Standard 6" Design, Proglaze ETA can be used in conjunction with most commonly used window and curtain wall systems.

Kevin Knight is President and Bryan Boyle is Operating Manager of Retro-Specs Consultants Ltd., a firm based in Winnipeg, Manitoba, Canada, specializing in building envelope commissioning, inspection and testing. Knight is also a founding member of the Air Barrier Association of America, a Board Member of the Building Environment and Thermal Envelope Council (BETEC) and sits on the ASTM E06 subcommittee and the ULC Standard Committee for Air Barriers.

Further Information

For assistance in the design and specification of transitions from window or curtain wall systems to wall assemblies that will ensure continuity and durability, contact:

. Peter Poirier, Technical Director, Tremco Glazing Solutions Group, 419-289-2050, ppoirier@tremcoinc.com
. Mike Sebold, Team Leader, Building Envelope Solutions, 216-292-5690, msebold@tremcoinc.com

References

1. Air-Ins Inc., "Air Permeance of Building Materials: Summary Report," Canada Mortgage and Housing Corporation, Ottawa, ON, June 1988.

2. Canada Mortgage and Housing Corporation, "2001 Building Failures Study," *Research Highlights, Technical Series 01-140*, Ottawa, ON, 2001.

3. Drysdale, R. G., "Construction Problems in Multi-Family Residential Buildings," Canada Mortgage and Housing Corporation, Ottawa, ON, March 1991.

4. Morrison Hershfield Limited, "Testing of Air Barrier Construction Details," Canada Mortgage and Housing Corporation, Ottawa, ON, August 1991.

5. Kubal, Michael T., "Waterproofing the Building Envelope," McGraw-Hill Professional, New York City, NY, 1992.

6. Weidt, J. and Weidt J., "Air Leakage in Newly Installed Residential Windows," U.S. Department of Energy, June 1980.

7. Quirouette, R., Marshall, S. and Rousseau, J., "Design Considerations for an Air Barrier System," Canada Mortgage and Housing Corporation, Ottawa, ON, November 2000.

8. Knight, K. D. and Boyle, B. J., "Guidelines for Delivering Effective Air Barrier Systems," Canada Mortgage and Housing Corporation, Ottawa, ON, 2004.

9. Hill, D., "Valuing Air Barriers," *Home Energy*, September/October 2001.

10. Woods, T., "Reducing Air Leakage Through the Building Envelope Cuts Energy Demand and Consumption," *Air Barriers III: Air Barrier Solutions for Buildings in North American Climates*, Washington, DC, 2001.

11. Scanada Consultants Ltd. and CanAm Building Envelope Specialists Inc., "Development of Design Procedures and Guidelines for Reducing Electric Demand by Air Leakage Control in High-Rise Residential Buildings," Ontario Hydro/Canada Mortgage and Housing Corporation, Ottawa, ON, 1991.

12. Pollock, *BETEC/DOE/ORNL Spring Symposium: Air Barrier Solutions*, 2001.

13. Drysdale, R. G. and Suter, G. T., "Exterior Wall Construction in High-Rise Buildings," Canada Mortgage and Housing Corporation, Ottawa, ON, 1991.

14. Proglaze® ETA Engineered Transition Assembly Data Sheet, Tremco Inc.

15. Proglaze® ETA Engineered Transition Assembly Installation Instructions, Tremco Inc.

16. Performance Test Report, Proglaze ETA, rendered to Tremco Incorporated by Architectural Testing Inc.

17. Performance Test Report, Air Barrier Material rendered to Tremco Incorporated by Architectural Testing Inc.

18. "Children's Hospital of Wisconsin, *West Tower Expansion*," Tremco Inc.