DOW CORNING High Performance Building Solutions

Innovative Sealant Technology Provides Design Flexibility for Air Tight Joints

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Outline

- Building Codes and Air Barriers
- Adhesion and System Performance
- A new type of sealant
- Difficult details with system performance

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Codes and Standards

- Buildings account for 39% of all energy use in the US*.
  - 18% of energy use is due to offsetting heating and cooling of air infiltrating the building envelope
- This led to building codes requiring the use of air barriers.
- The next generation of building codes will require system performance testing.

* Data from US DOE EERE

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Codes and Standards

Standard or Code	Air Leakage Rates at 0.3 in. w.g. (1.57 lb/sqft, 75 Pa)	Tests Cited
ASHRAE 90.1-2010	Material: 0.004 cfm/sqft Assembly: 0.04 cfm/sqft	ASTM E 2178, ASTM E 2357, ASTM E 1677, ASTM E 1680, ASTM E 283
ASHRAE 189.1-2009	Material: 0.004 cfm/sqft Assembly: 0.04 cfm/sqft Building: 0.4 cfm/sqft	ASTM E 2178, ASTM E 2357, ASTM E 1677, ASTM E 1680, ASTM E 283, ASTM E 779
IECC - 2012	Material: 0.004 cfm/sqft Assembly: 0.04 cfm/sqft	ASTM E 2178, ASTM E 2357, ASTM E 1677, ASTM E 1680, ASTM E 283
IgCC - 2012	Envelope: 0.25 cfm/sqft	
USACE	Envelope: 0.25 cfm/sqft	

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The Challenge of Air Barriers

- Self-adhered flashings typically have high-density polyethylene (HDPE) backings
  - HDPE is a very low surface energy material
  - Very difficult for traditional sealants to adhere
- Spun-bound polyolefin sheets are fibrous wrap materials which are mechanically attached to the building
  - Also low surface energy
- Many air barriers offer limited movement capability. They are not able to accommodate movement imparted at control joints and interfaces with other building materials.

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System Performance

- Does adhesion make a difference?
- Tested a system to ASTM E283-04

- 3 Cases
  - Sealant that adheres to the membrane
  - Sealant that “adheres” until stressed
  - Same sealant after it has seen cyclical movement and lost adhesion

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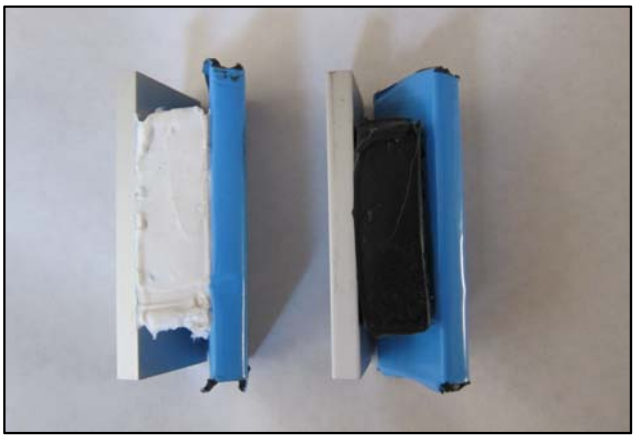

Polymer/resin blend sealant joint after being tested for +/- 25% movement (left) and standard silicone sealant joint after being tested for +/- 25% movement (right). Substrates are anodized aluminum and HDPE.

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With and Without Adhesion

Pressure	Initial Tare (cfm)	Infiltration		Exfiltration	
		With Sealant Adhered	Without Sealant Adhered	With Sealant Adhered	Without Sealant Adhered
25 Pa (0.52 psf)	0.11	<0.01	0.12	<0.01	0.1
50 Pa (1.04 psf)	0.22	<0.01	0.19	<0.01	0.18
75 Pa (1.57 psf)	0.33	0.01	0.27	<0.01	0.24
100 Pa (2.09 psf)	0.42	<0.01	0.34	<0.01	0.31
150 Pa (3.13 psf)	0.61	<0.01	0.45	<0.01	0.4
250 Pa (5.22 psf)	0.94	<0.01	0.67	<0.01	0.58
300 Pa (6.27 psf)	1.08	<0.01	0.74	0.01	0.64

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Solution to air infiltration concerns

- Material that is…
  - Remains flexible under long-term loading
  - Does not tear apart the fragile air barrier materials
- Designed to adhere to low energy surfaces
- Looked beyond traditional silicone polymers to the world of resins
- A mixture of a traditional silicone polymer with a silica resin.

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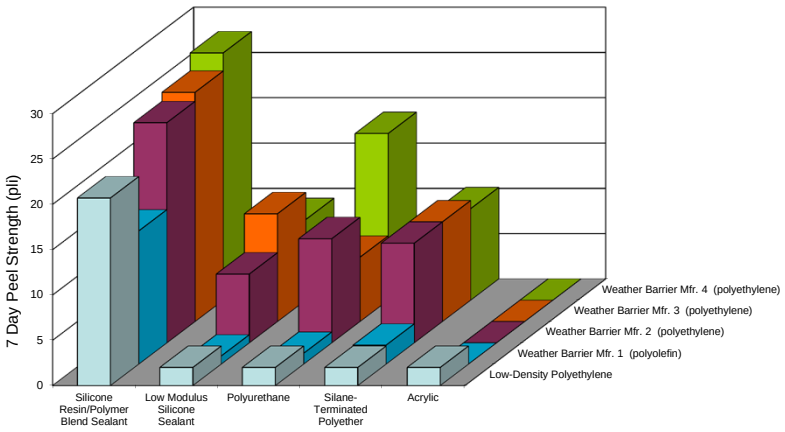
Adhesion Performance of Polymer-Resin Sealant to Low Energy Substrates



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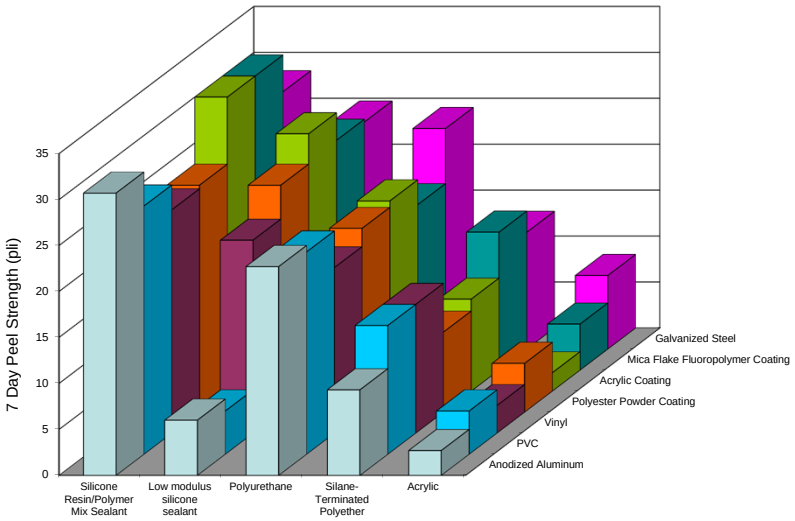
Adhesion to Traditional Substrates



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Both Before and After QUV Exposure

	7 Day RT	1000 Hr RT	1000 Hr QUV	5000 Hr RT	5000 Hr QUV	10,000 Hr RT	10,000 QUV	Reference traditional sealant value
Peel Strength on Glass (pli)	62	69	70	83	60	85	62	20-50
Durometer (A Scale)	NA	55	53	57	53	63	60	30-40
Tensile Strength (psi)	NA	399	334	459	332	424	301	150-250

*RT = Room Temperature

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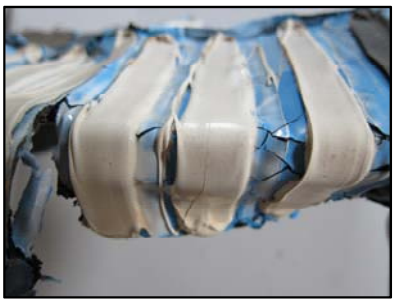
Weathering



Silicone Polymer Resin Blend Sealant after 2 years in Phoenix Desert Outdoor Weathering Site. No cleaning or special preparation of the sealant. Substrate is a common SAF weather barrier membrane.

Organic technology sealant after 2 years in Phoenix Desert Outdoor Weathering Site. No cleaning or special preparation of the sealant. Substrate is a common SAF weather barrier membrane.

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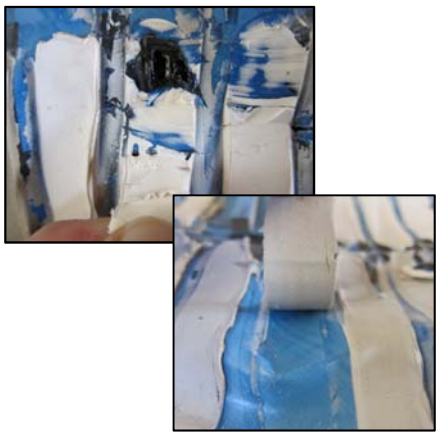
Weathering + Adhesion



Adhesion of polymer/resin blend sealant (left) and a common silicone sealant (right) after 2 years in Phoenix Desert Outdoor Weathering Site, to a common peel and stick weather barrier membrane with a high density polyethylene top sheet.

Adhesion of polymer/resin blend sealant (right) and a common silicone sealant (left) after 2 years in Phoenix Desert Outdoor Weathering Site, to a common spun bound polyolefin weather barrier membrane

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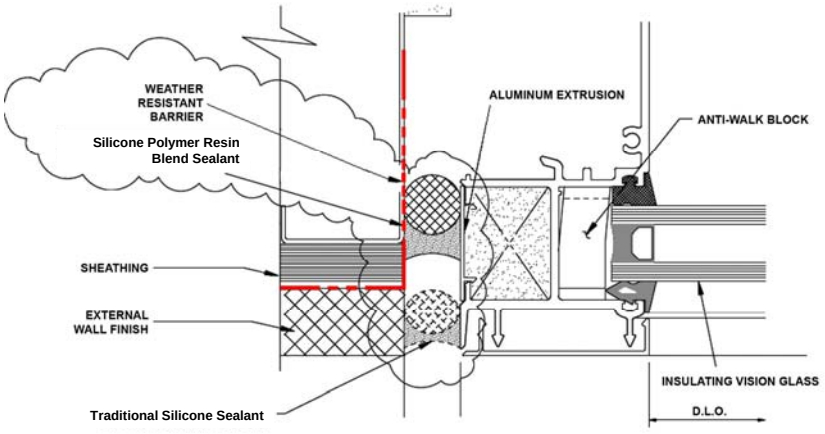
Application Example



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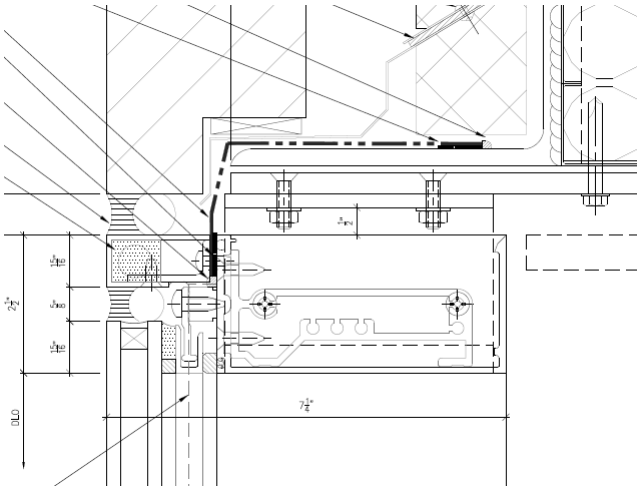
What happens when things are not so simple?



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Pre-cured Extrusions

- Allow for spanning gaps and angles that are difficult with sealant
- Must meet same air infiltration standards as sealant.
- Ability to take movement of joint without failure

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Air infiltration – Material properties

Test Method	Air Leakage	Water Leakage
E-283	0.021 cfm	
E-331		No Leakage

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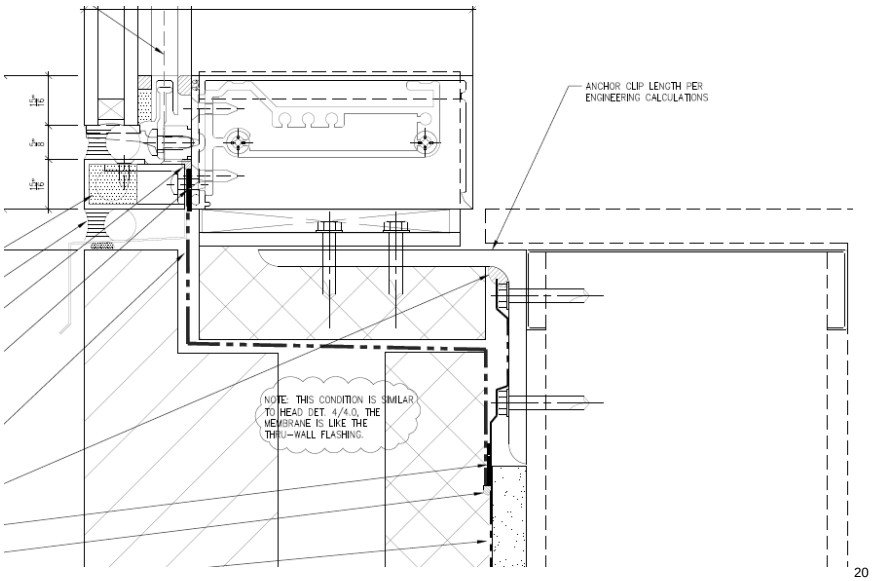
The details are not always so simple



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Performance of Intricate Assemblies

- Air Leakage Rate (ASTM E 283)
- Static Water Pressure Resistance (ASTM E 331)
- Dynamic Water Pressure Resistance (AAMA 501.1)
- Structural Performance (ASTM E 330)

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Water: The Universal “Find-its-way-er”

- Systems can pass ASTM E 283 for air leakage rate but may still fail water resistance
- Sealing of screw heads
- Extrusion must be lapped to shed water
- Forcing structural deflections of system and retesting for water and air may reveal failures

Structural Loading Then Water and Air

- Standard testing
  - Max Load ±30 psf
- Overload testing
  - Max Load ±45 psf
- No tearing
- No loss of adhesion

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Conclusions

- Sealant adhesion plays a key role in minimizing air leakage.
- Curtain wall and window installations currently rely on organic flashing materials
- Sealant chemistry and adhesion performance will affect air infiltration performance of a curtain wall or window installation
- Unique sealant chemistry with a resin component designed to adhere to low surface energy materials assures long term adhesion and low air infiltration performance of a whole installation
- Pre-cured silicone extrusions allow for design flexibility at material interfaces

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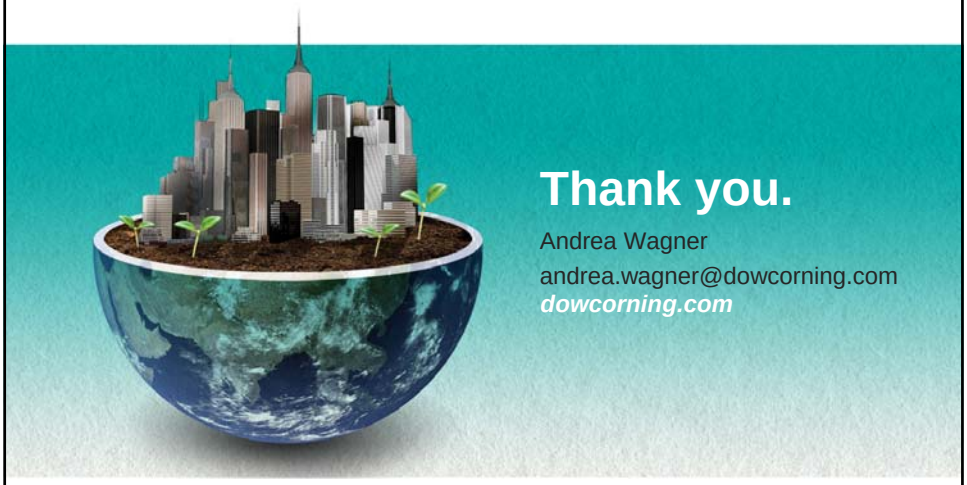

Thank you.

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BUILD A BETTER BARRIER

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