Sealant Adhesion Study

Walsh Construction Company, Quality

Sharon Libby

Thank You:

Atlas Supply

Test Materials Generously Provided By:

Atlas Supply, Dow Corning, Tremco, STO, BASF, BEI / Prosoco, Henry Company, OSI, Firestone, Cascadia, VPI Quality Windows, Trespa, Waterblock Building Systems, Skyline Sheet Metal, B&B Tile & Masonry, Lakeside Lumber

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Learning Objectives

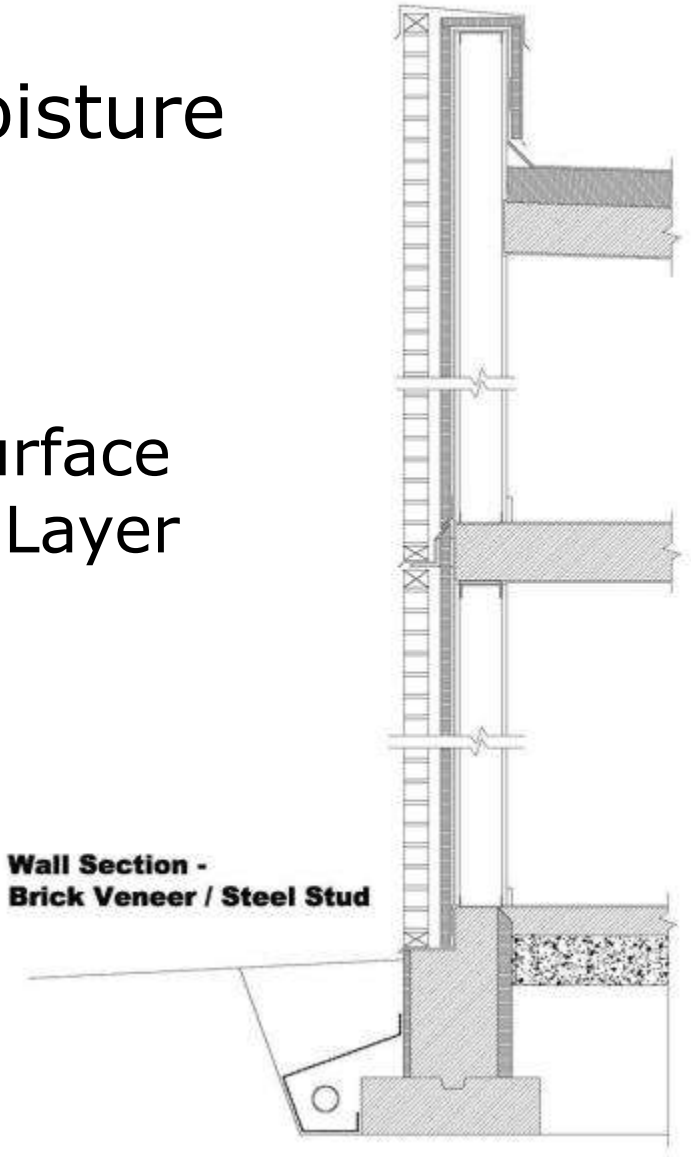
- Understand basic steps on how to develop and conduct a material study.
- Understand how testing methods were adapted.
- Understand how the collected data was analyzed.
- Understand how tested results can compare and relate to field results.
- Gain a general understanding of sealant and substrate chemistry in relation to expected in-field performance.

Sealant Study Disclaimer

- This experiment is not per any ASTM standard:
  - The scope of materials tested is limited to typical substrates and sealants.
  - While the testing conditions were relatively controlled and consistent, they were not done under lab testing conditions.
- The results do not replace field testing!
  - This study is intended to provide a comparative analysis that can be used generally to aid in understanding the adhesion and compatibility of sealants and substrates.
  - Field testing should always be conducted and include the actual materials and conditions.

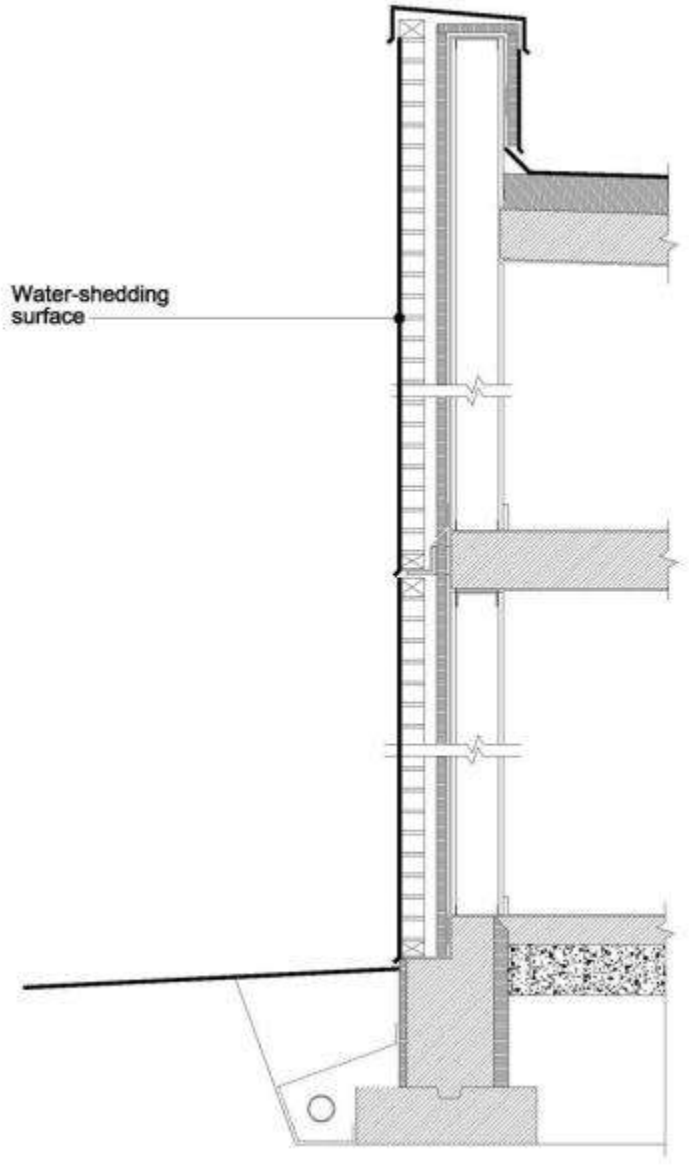
Why do we care about sealants? How are they used in construction?

- Sealants in Air and Moisture Control Layers
- 5 Control Layers:
  - Bulk Water Shedding Surface
  - Water Resistive Control Layer
  - Air Control Layer
  - Thermal Control Layer
  - Vapor Control Layer
- Continuity is Key!



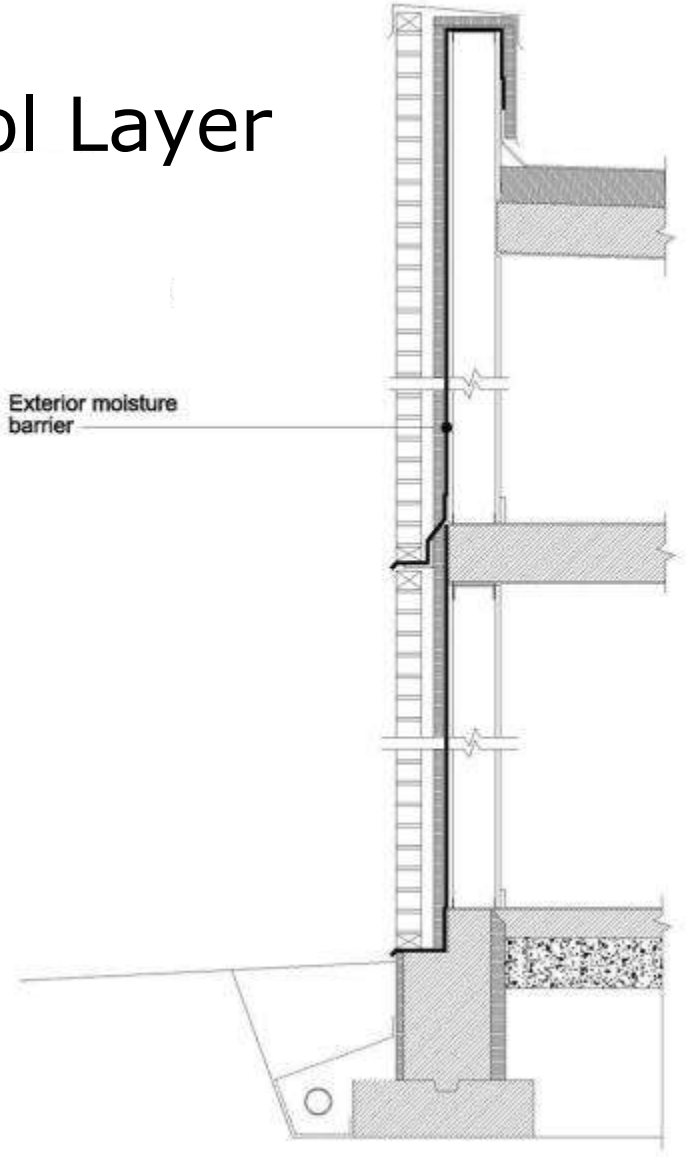
Why do we care about sealants? How are they used in construction?

- Bulk Water Shedding Surface
  - Sealants?
  - Window perimeters
  - Cladding material intersections
  - Base of wall to finished patio or deck
  - Etc.



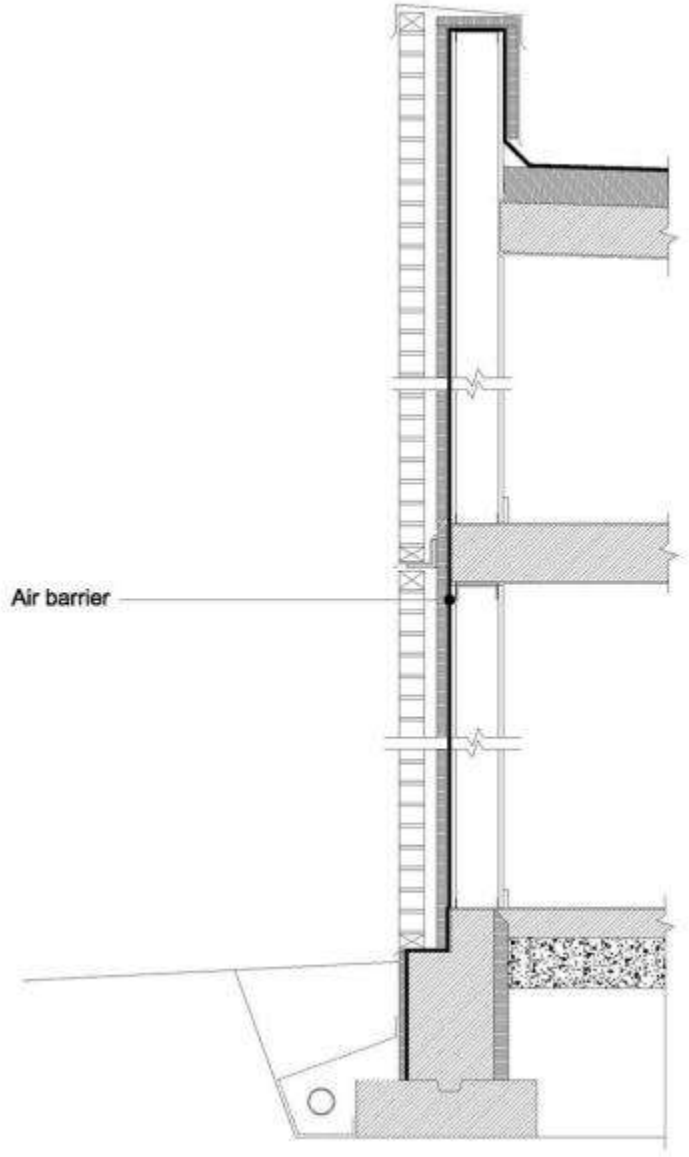
Why do we care about sealants? How are they used in construction?

- Water Resistive Control Layer
  - Sealants?
  - Penetrations
  - Transitions
  - Terminations



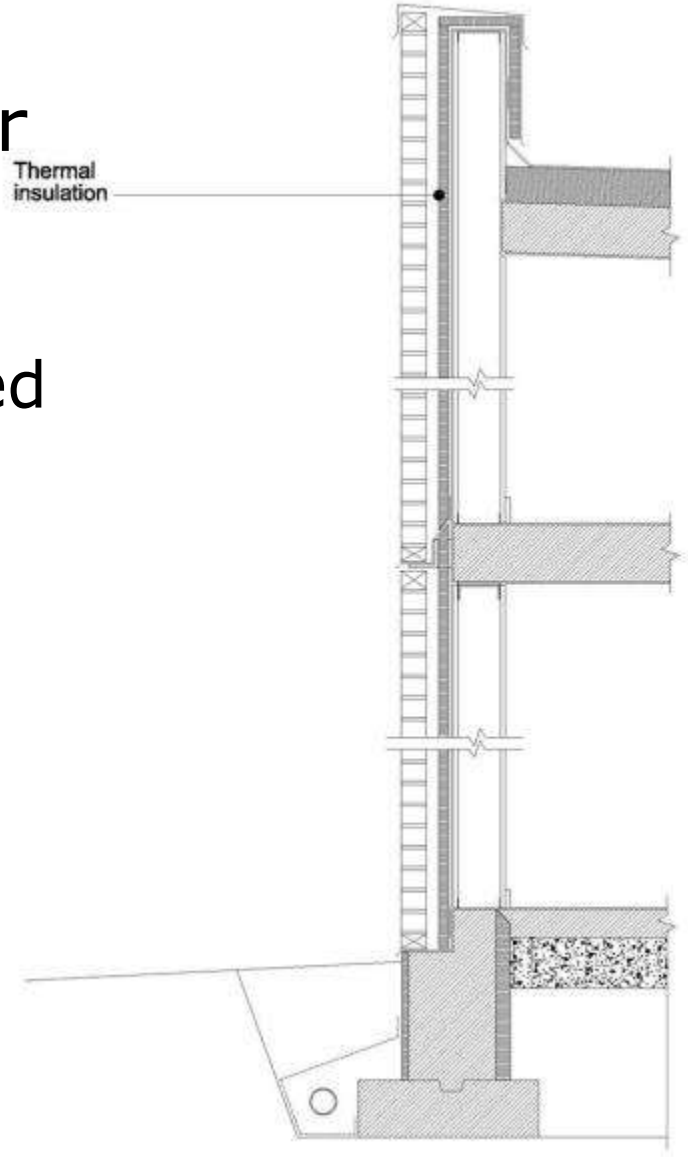
Why do we care about sealants? How are they used in construction?

- Air Control Layer
  - Sealants?
  - In conjunction with sheet air barriers to provide continuity
  - Window air seal
  - Door air seal
  - Interior air seals at ceilings or party walls



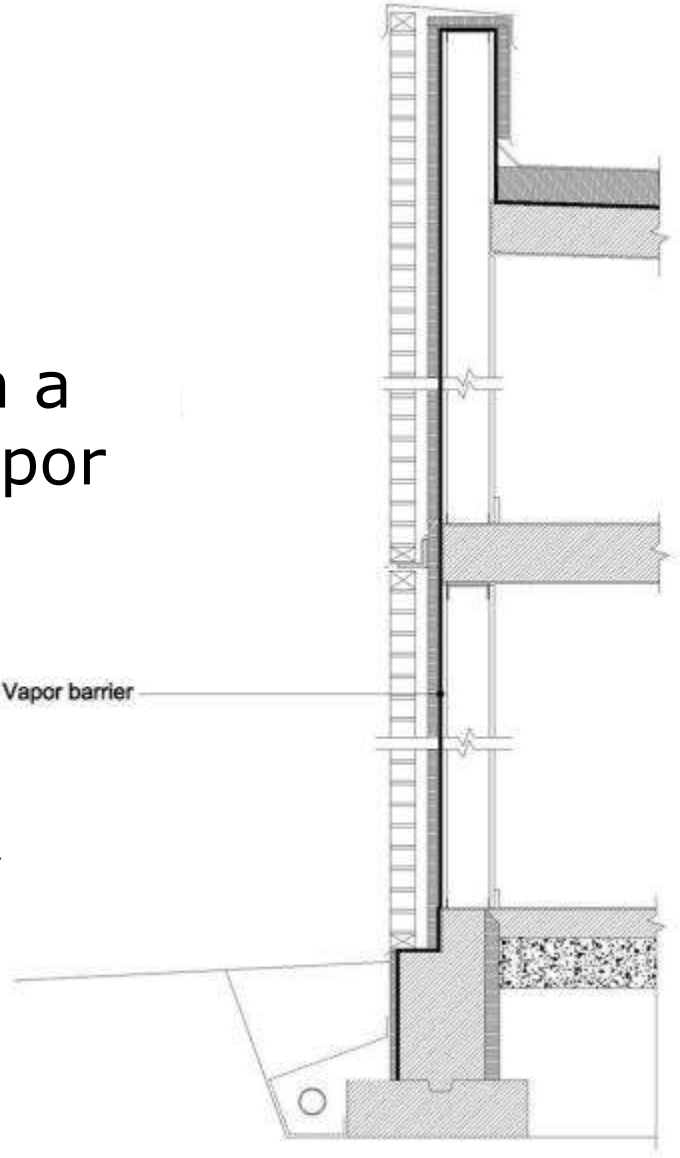
Why do we care about sealants? How are they used in construction?

- Thermal Control Layer
  - Sealants?
  - Not typical, but are used to limit heat transfer such as fire stopping



Why do we care about sealants? How are they used in construction?

- Vapor Control Layer
  - Sealants?
  - Used in conjunction with a SAM as the air/water/vapor control layer
  - Sometimes with interior vapor control
  - Not a focus in this study



Why do we care about sealants? How are they used in construction?

- Continuity of Control Layers
  - Continuity is required at field areas and at interfaces such as:

  Penetrations, Transitions, & Terminations

- Sealants Provide Continuity at Control Layers

The Purpose of the Experiment

To verify adhesion and compatibility

- Adhesion; resistance measured in pounds

The Purpose of the Experiment

To verify adhesion and compatibility

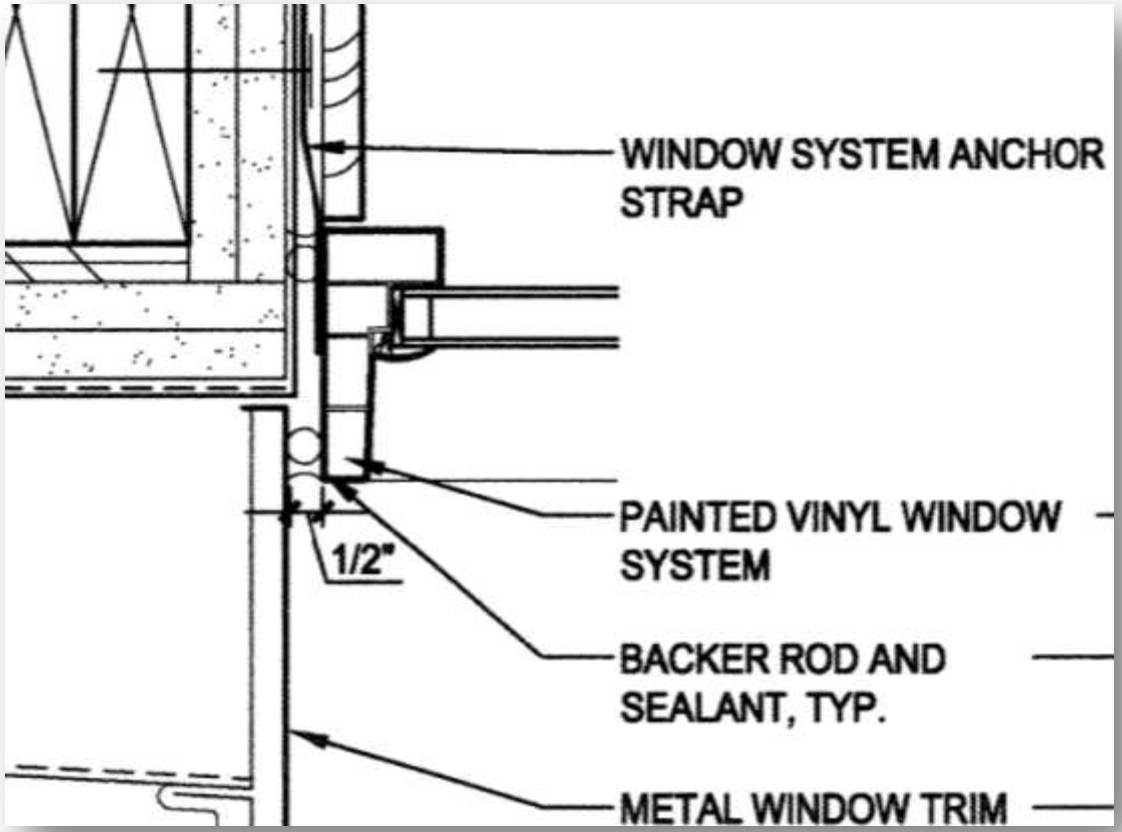
- Compatibility; observed reactions
- No UV was used in this experiment

The Purpose of the Experiment

- The Goals of the Study
  - Observe and compare sealants and substrates
  - Test recommended and inadvertent applications
  - Gain a general understanding of sealant and substrate chemistry in relation to expected in-field performance.
  - Measure adhesion and record modes of failure
  - Compare the results – quantitative & qualitative

Sealants to Substrates - Pairings

- **Designed material contact**
- Everything is perfect in drawings – thanks architects!



Sealants to Substrates - Pairings

- **Inadvertent material contact**
- When transitions occur in construction that were unanticipated or not designed
- Mt. Hood Community College
- Conducted adhesion testing for interior air seal: WRB to window
- A sealant was found to have good adhesion to both the WRB and the window frame
- Wait, why is the SAM melting?

Sealants to Substrates - Pairings

- **Inadvertent material contact**

- A leading edge bleed was noticed; the adhesive backing of the SAM was reacting with something and melting
- A subcontractor thought to use the interior air-seal sealant to bed the window flange.
- No testing was conducted for the sealant and SAM, since they were not expected to be in contact
- Removal and reinstallation of 83 windows

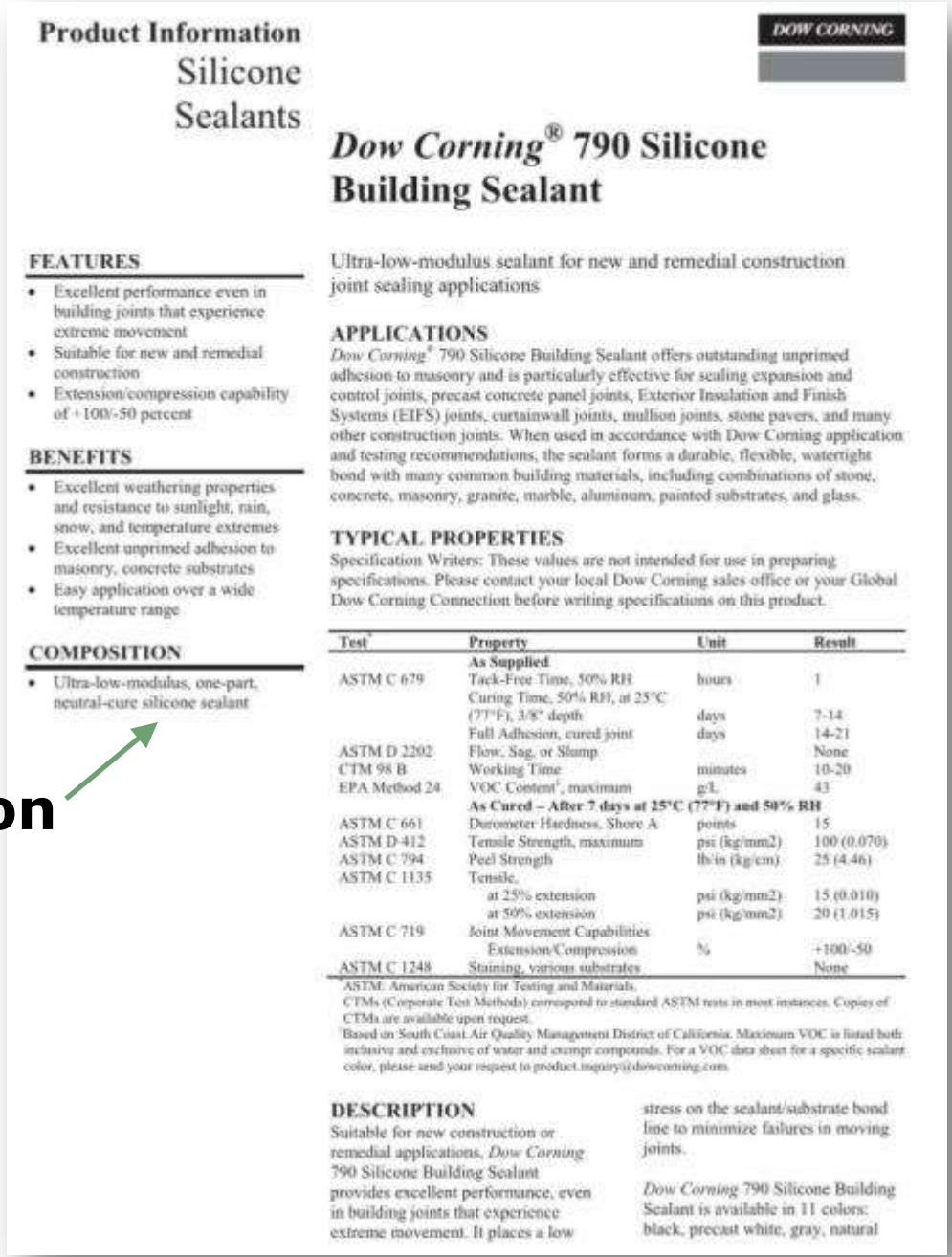
Sealants to Substrates - Pairings

- **Inadvertent material contact**

Can really throw a wrench in things …

Related Testing

- Manufacturer
- Research & Design
- **Data Sheet**
  - **Chemical Composition**



Product Information
Silicone
Sealants

DOW CORNING

Dow Corning® 790 Silicone Building Sealant

FEATURES
- Excellent performance even in building joints that experience extreme movement
- Suitable for new and remedial construction
- Extension/compression capability of +100/-50 percent

BENEFITS
- Excellent weathering properties and resistance to sunlight, rain, snow, and temperature extremes
- Excellent unprimed adhesion to masonry, concrete substrates
- Easy application over a wide temperature range

COMPOSITION
- Ultra-low-modulus, one-part, neutral-cure silicone sealant

Ultra-low-modulus sealant for new and remedial construction joint sealing applications

APPLICATIONS
Dow Corning® 790 Silicone Building Sealant offers outstanding unprimed adhesion to masonry and is particularly effective for sealing expansion and control joints, precast concrete panel joints, Exterior Insulation and Finish Systems (EIFS) joints, curtainwall joints, mullion joints, stone pavers, and many other construction joints. When used in accordance with Dow Corning application and testing recommendations, the sealant forms a durable, flexible, watertight bond with many common building materials, including combinations of stone, concrete, masonry, granite, marble, aluminum, painted substrates, and glass.

TYPICAL PROPERTIES
Specification Writers: These values are not intended for use in preparing specifications. Please contact your local Dow Corning sales office or your Global Dow Corning Connection before writing specifications on this product.

Test[A]	Property	Unit	Result
	As Supplied		
ASTM C 679	Tack-Free Time, 50% RH	hours	1
	Curing Time, 50% RH, at 25°C (77°F), 3/8" depth	days	7-14
	Full Adhesion, cured joint	days	14-21
ASTM D 2202	Flow, Sag, or Slump		None
CTM 98 B	Working Time	minutes	10-20
EPA Method 24	VOC Content[C], maximum	g/L	43
	As Cured – After 7 days at 25°C (77°F) and 50% RH		
ASTM C 661	Durometer Hardness, Shore A	points	15
ASTM D 412	Tensile Strength, maximum	psi (kg/mm2)	100 (0.070)
ASTM C 794	Peel Strength	lb/in (kg/cm)	25 (4.46)
ASTM C 1135	Tensile,		
	at 25% extension	psi (kg/mm2)	15 (0.010)
	at 50% extension	psi (kg/mm2)	20 (1.015)
ASTM C 719	Joint Movement Capabilities		
	Extension/Compression	%	+100/-50
ASTM C 1248	Staining, various substrates		None

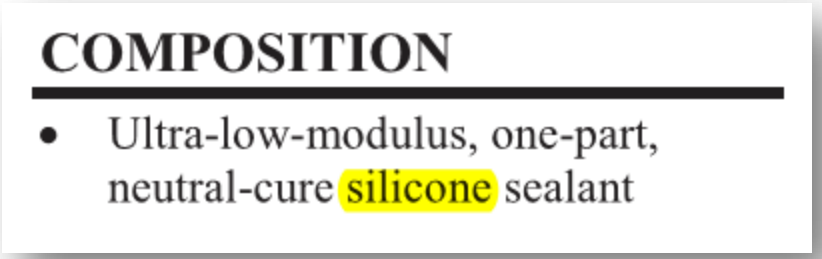
[A] ASTM: American Society for Testing and Materials.
CTMs (Corporate Test Methods) correspond to standard ASTM tests in most instances. Copies of CTMs are available upon request.
[C] Based on South Coast Air Quality Management District of California. Maximum VOC is listed both inclusive and exclusive of water and exempt compounds. For a VOC data sheet for a specific sealant color, please send your request to product.inquiry@dowcorning.com.

DESCRIPTION
Suitable for new construction or remedial applications, *Dow Corning* 790 Silicone Building Sealant provides excellent performance, even in building joints that experience extreme movement. It places a low stress on the sealant/substrate bond line to minimize failures in moving joints.

Dow Corning 790 Silicone Building Sealant is available in 11 colors: black, precast white, gray, natural

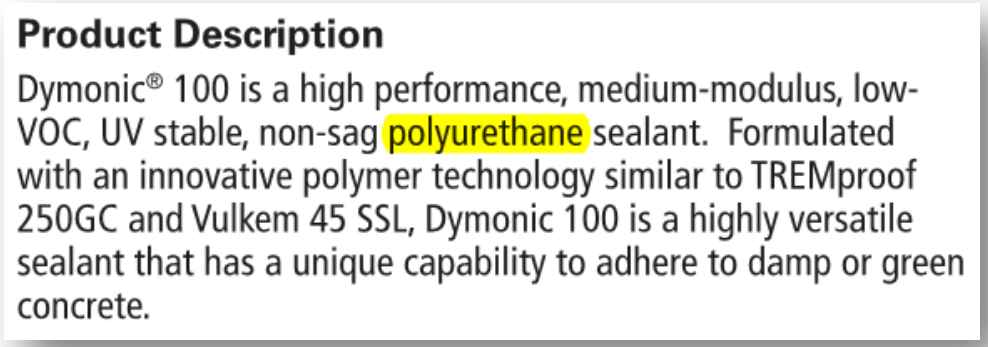
Related Testing

- Manufacturer
- Research & Design
- **Data Sheet**
  - **Chemical Composition**:
  - Silicone
  - Silyl Terminated Polyether (STPe)
  - Polyurethanes
  - Polymers – elastomeric, acrylic, etc.



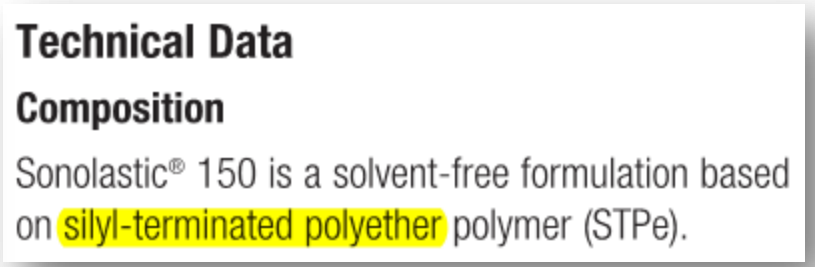
COMPOSITION

- Ultra-low-modulus, one-part, neutral-cure silicone sealant



Product Description

Dymonic® 100 is a high performance, medium-modulus, low-VOC, UV stable, non-sag polyurethane sealant. Formulated with an innovative polymer technology similar to TREMproof 250GC and Vulkem 45 SSL, Dymonic 100 is a highly versatile sealant that has a unique capability to adhere to damp or green concrete.



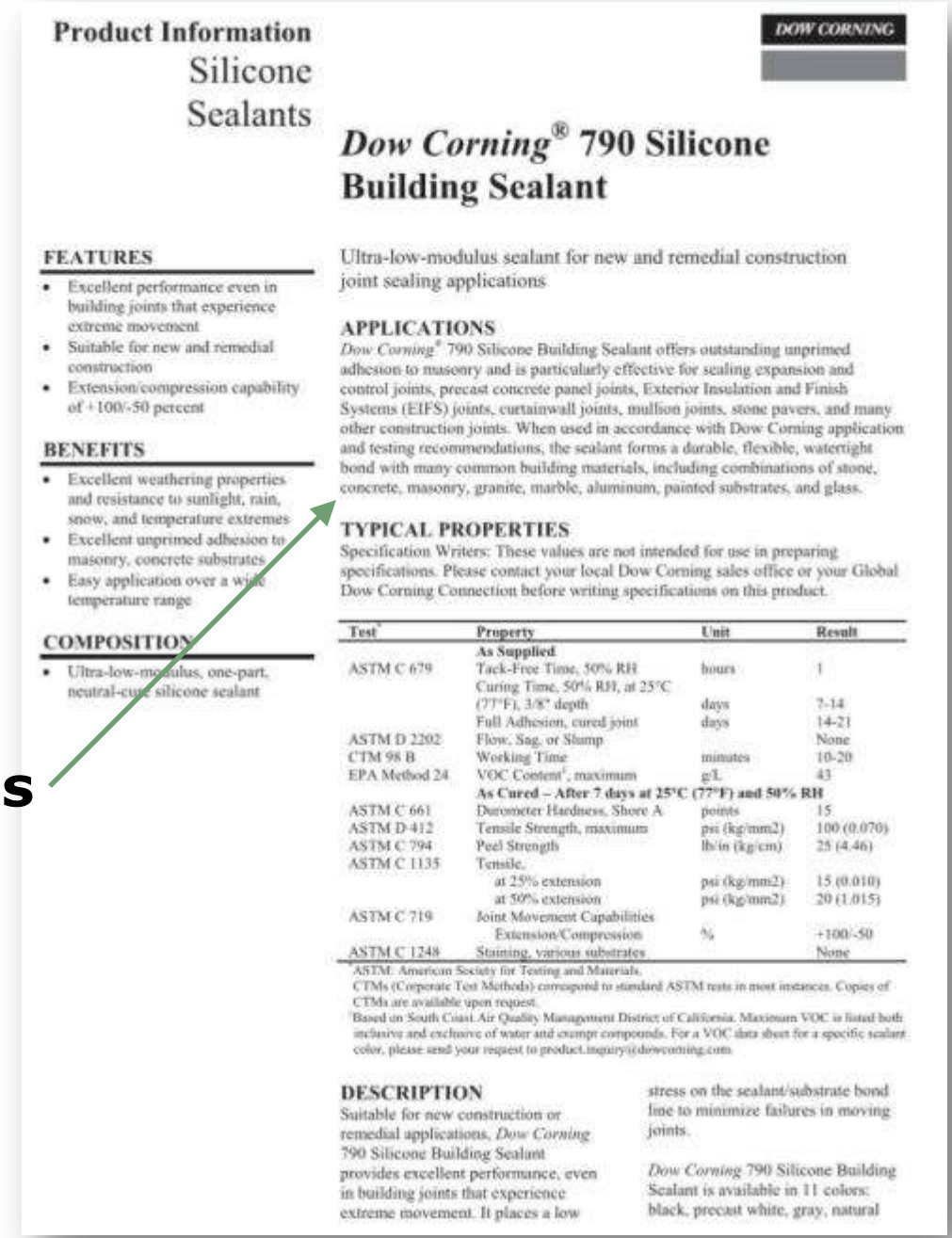
Technical Data

Composition

Sonolastic® 150 is a solvent-free formulation based on silyl-terminated polyether polymer (STPe).

Related Testing

- Manufacturer
- Research & Design
- **Data Sheet**
  - Chemical Composition
  - **Approved Substrates**



Product Information
Silicone
Sealants

DOW CORNING

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- Suitable for new and remedial construction
- Extension/compression capability of +100/-50 percent

BENEFITS
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- Excellent unprimed adhesion to masonry, concrete substrates
- Easy application over a wide temperature range

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Ultra-low-modulus sealant for new and remedial construction joint sealing applications

APPLICATIONS
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	Full Adhesion, cured joint	days	14-21
ASTM D 2202	Flow, Sag, or Slump		None
CTM 98 B	Working Time	minutes	10-20
EPA Method 24	VOC Content†, maximum	g/L	43
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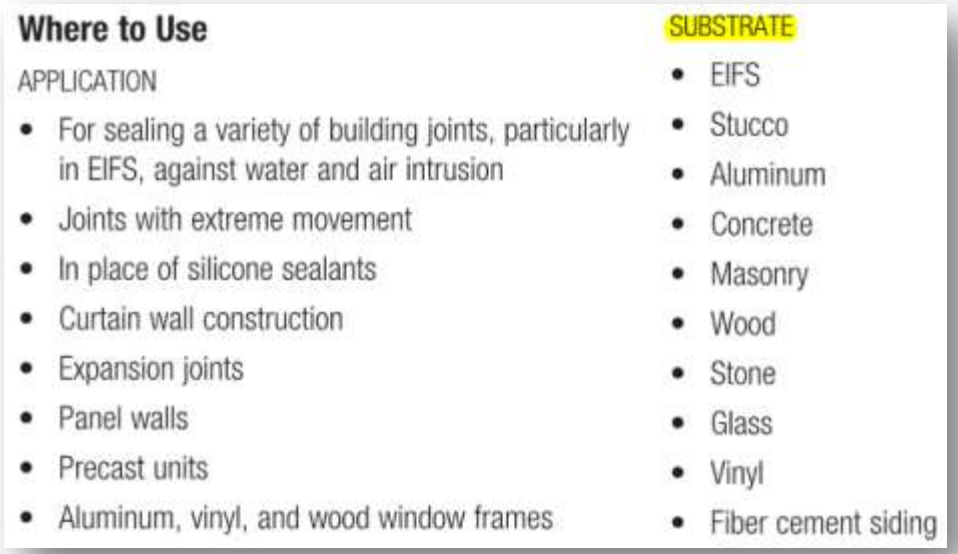
Related Testing

- Manufacturer
- Research & Design
- **Data Sheet**
  - **Approved Substrates**



Where to Use

APPLICATION

- For sealing a variety of building joints, particularly in EIFS, against water and air intrusion
- Joints with extreme movement
- In place of silicone sealants
- Curtain wall construction
- Expansion joints
- Panel walls
- Precast units
- Aluminum, vinyl, and wood window frames

SUBSTRATE

- EIFS
- Stucco
- Aluminum
- Concrete
- Masonry
- Wood
- Stone
- Glass
- Vinyl
- Fiber cement siding

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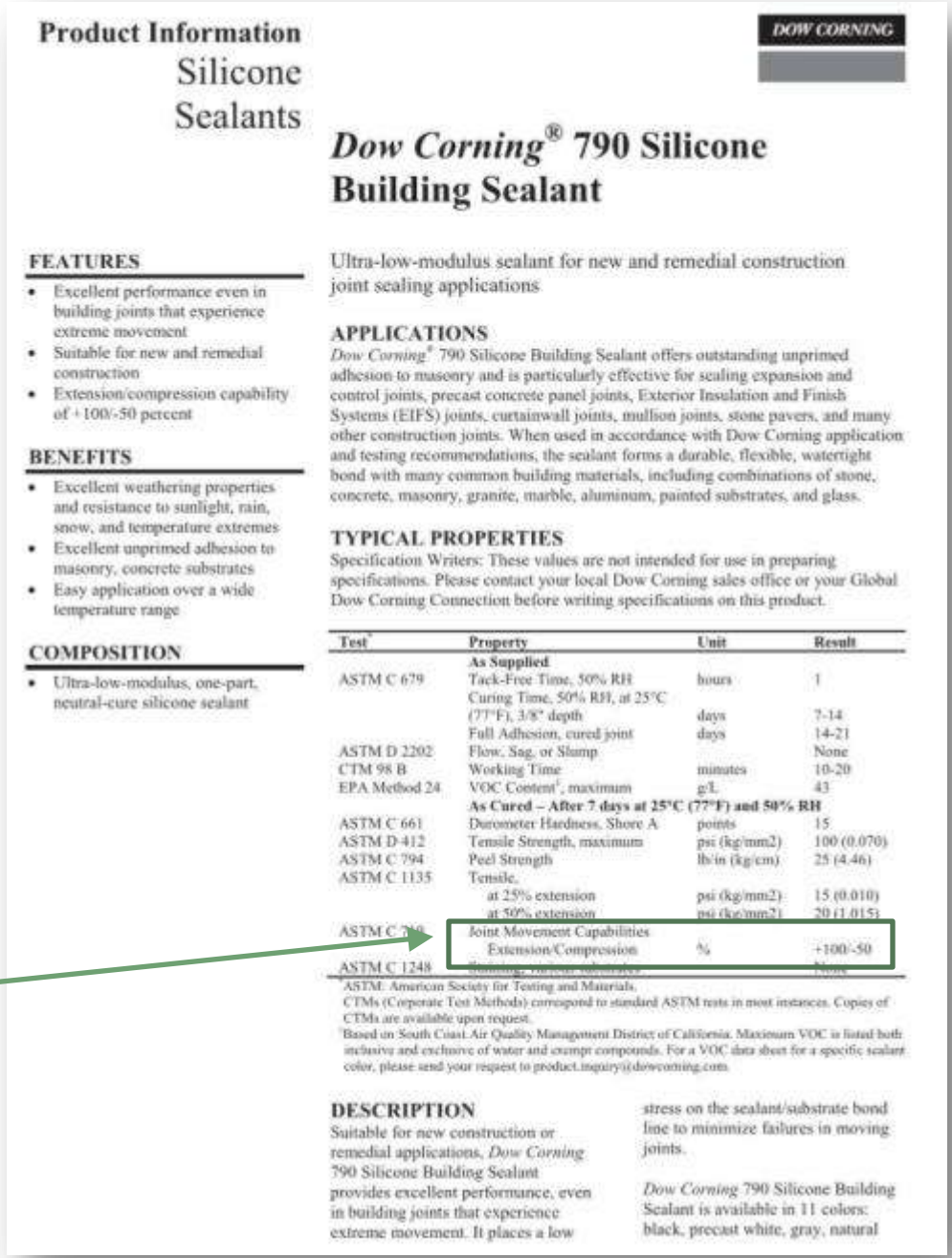
Related Testing

- Manufacturer
- Research & Design
- **Data Sheet**
  - Chemical Composition
  - Approved Substrates
  - **Properties**



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Related Testing

- Manufacturer
- Research & Design
- **Data Sheet**
  - **Properties:**
  - Test Method & Results
  - Joint Movement Capabilities
  - Working Time
  - Cure Time
  - VOC Content

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Related Testing

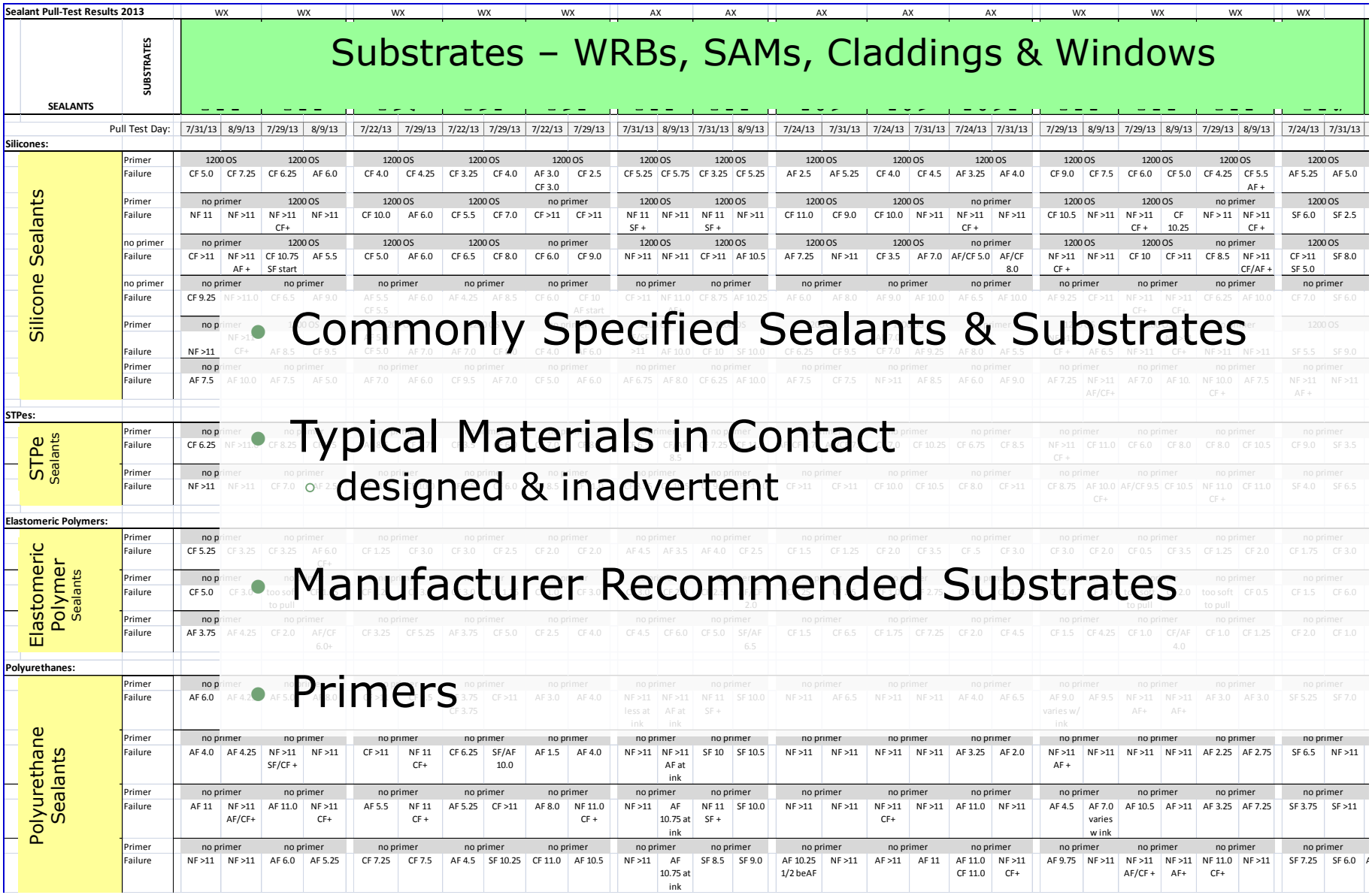
- Pre-construction
  - Material adhesion, in the lab
  - Material adhesion, in the field
  - Mock–up adhesion, compatibility, & performance

- **Study closely relates to field adhesion testing**
  - It does not take the place of other lab or field tests
  - Field testing should always be conducted and include the actual materials and conditions.

Related Testing

- In-service Joint Testing
  - ASTM 1521-09

The Test Pairings - Matrix



The Test Pairings - Sealants

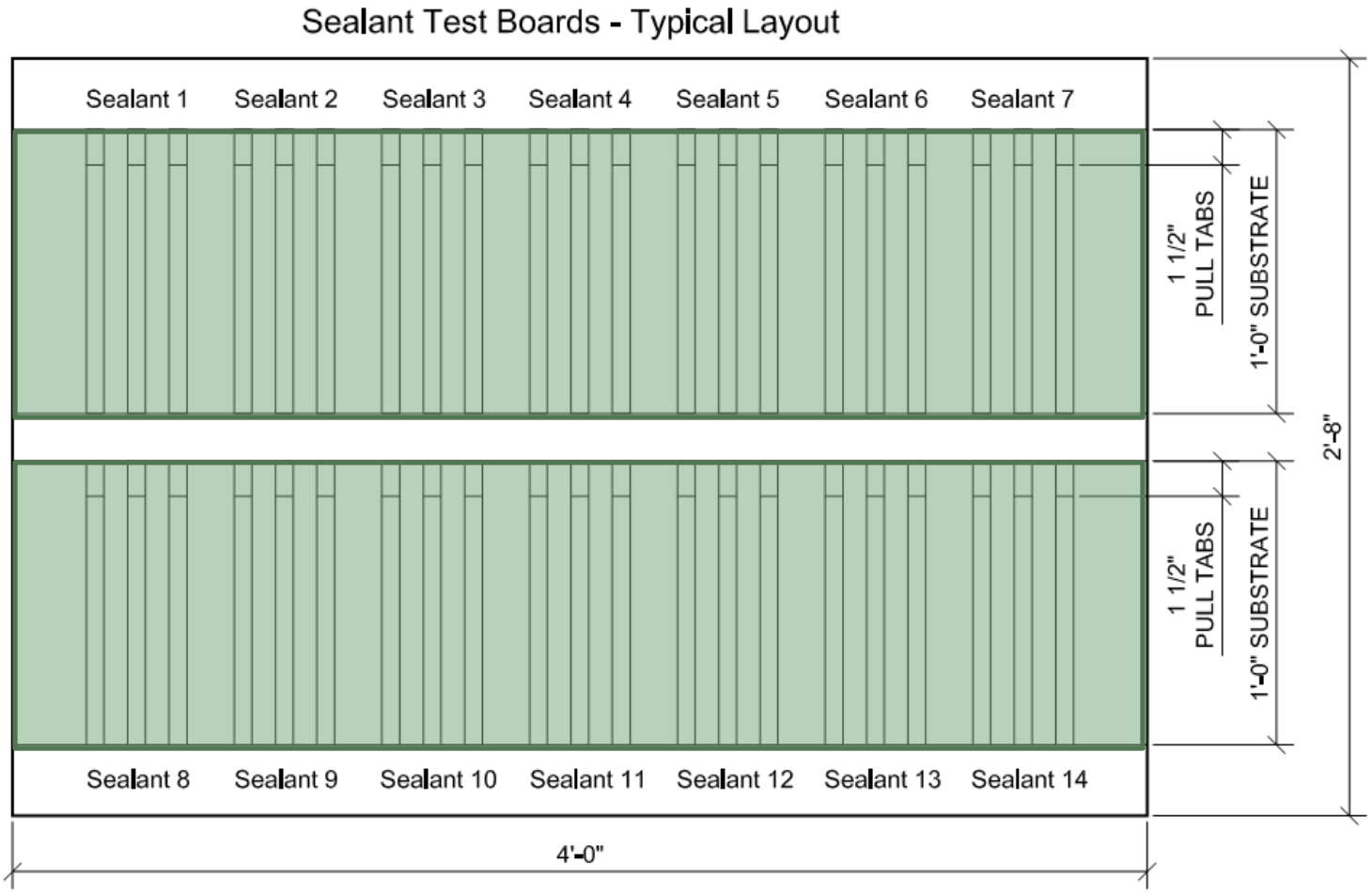
- **Silicone**
- **Silyl Terminated Polyether (STPe)**
- **Elastomeric Polymers**
- **Polyurethane**
- **Primers**
  - Per sealant manufacturer

The Test Pairings - Substrates

- **Weather Resistive Barriers (WRBs)**
  - Mechanically attached* polyethylene
  - Vapor permeable
- **Liquid Applied Membranes (LAMs)** - vapor permeable
  - Acrylic latex
  - Silicone
  - Silyl Terminated Polyether (STPe)
  - Styrene Butadiene Resin (SBR) synthetic rubber
  - Water-based elastomeric emulsion
- **Self Adhered Membranes (SAMs)**
  - Butyl & asphalt based adhesive backing
  - Foil & polyethylene facing
  - Non-vapor permeable
- **Claddings, Windows, & Roofing**
  - Fiber cement siding & trim
  - High-pressure laminate panel
  - PVC & poly-ash trim
  - Masonry
  - Metal panel
  - Wood
  - Fiberglass & vinyl window frames
  - Thermoplastic polyolefin

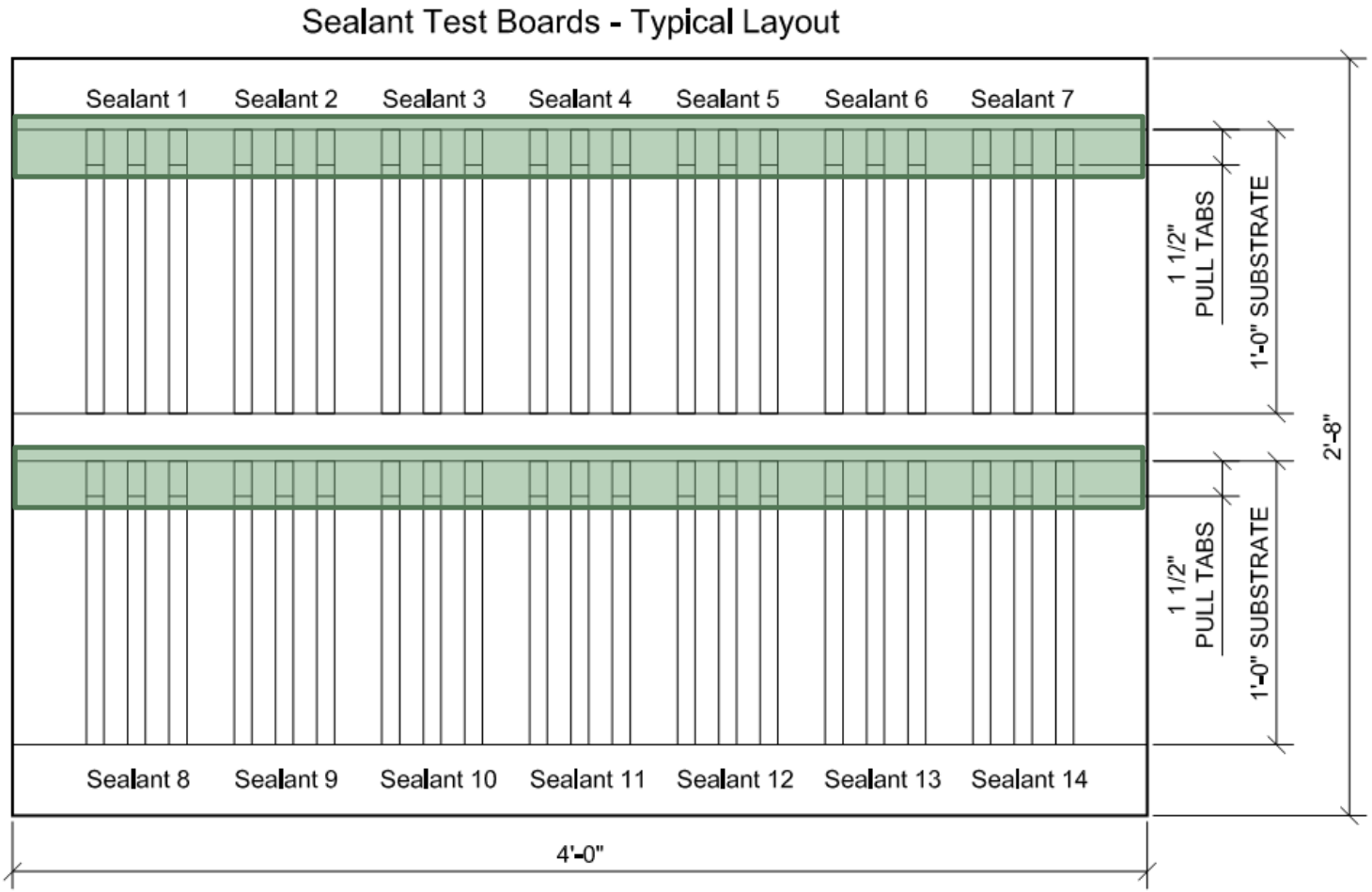
The Test Boards

- Test Board Set-up:
  - 32”x48” Boards
  - (2) 12”x48” Strips of material



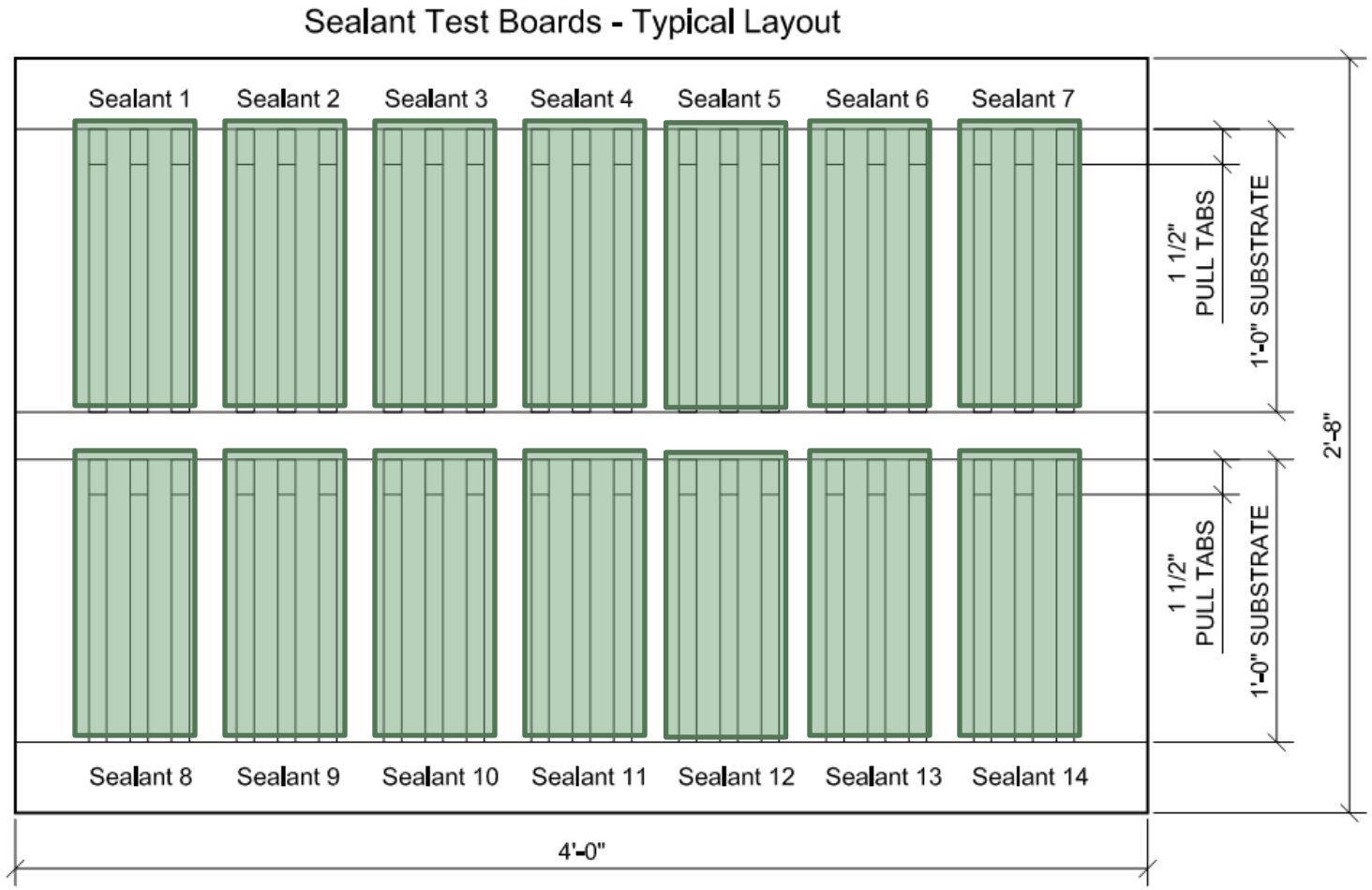
The Test Boards

- Test Board Set-up:
  - 1-2” Pull Tabs



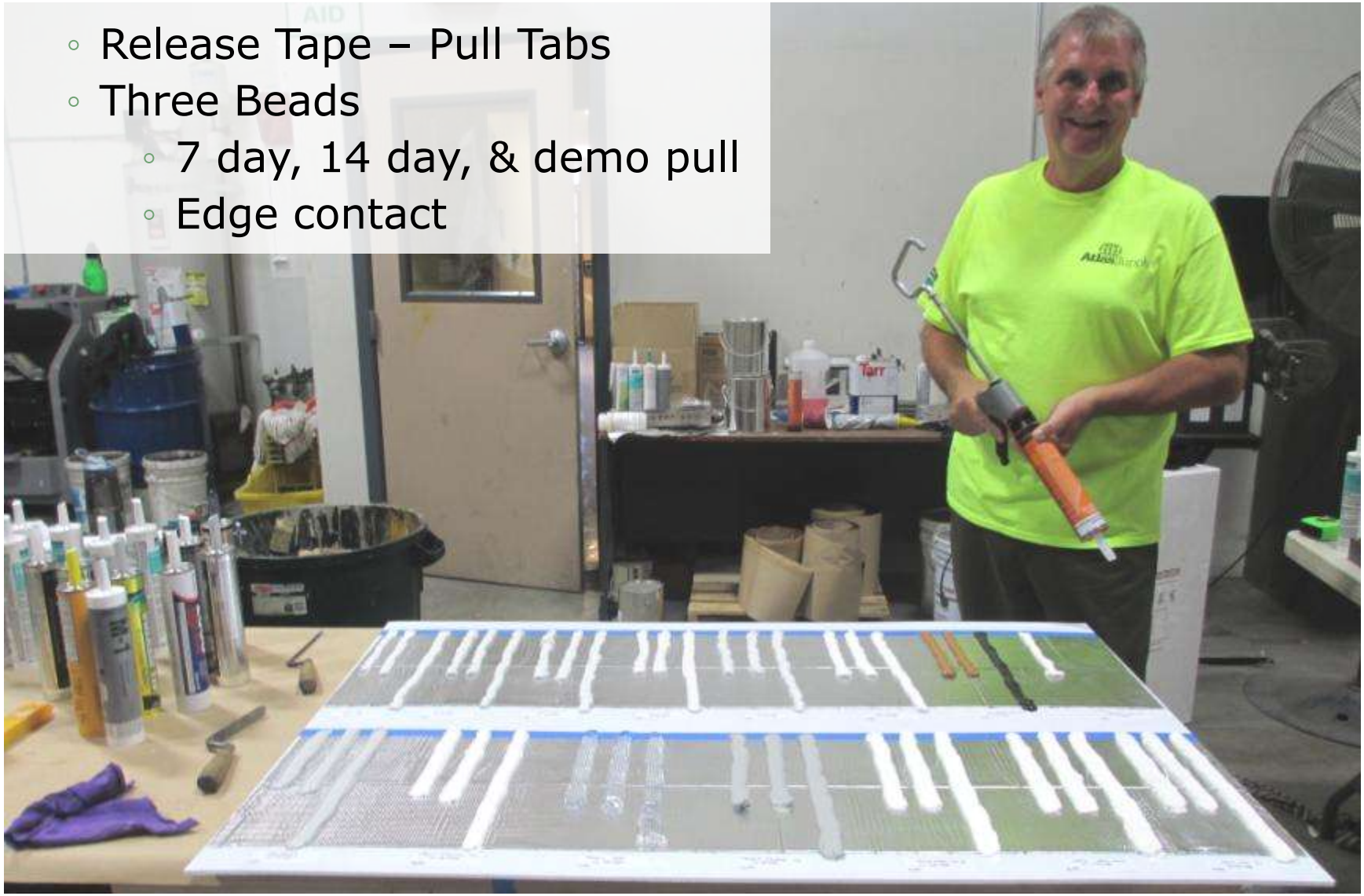
The Test Boards

- Test Board Set-up:
  - (3) Beads of each sealant
  - 14 – 16 Different sealants



The Test Boards

- Sealant Application:
  - Release Tape – Pull Tabs
  - Three Beads
    - 7 day, 14 day, & demo pull
    - Edge contact



The Test Boards

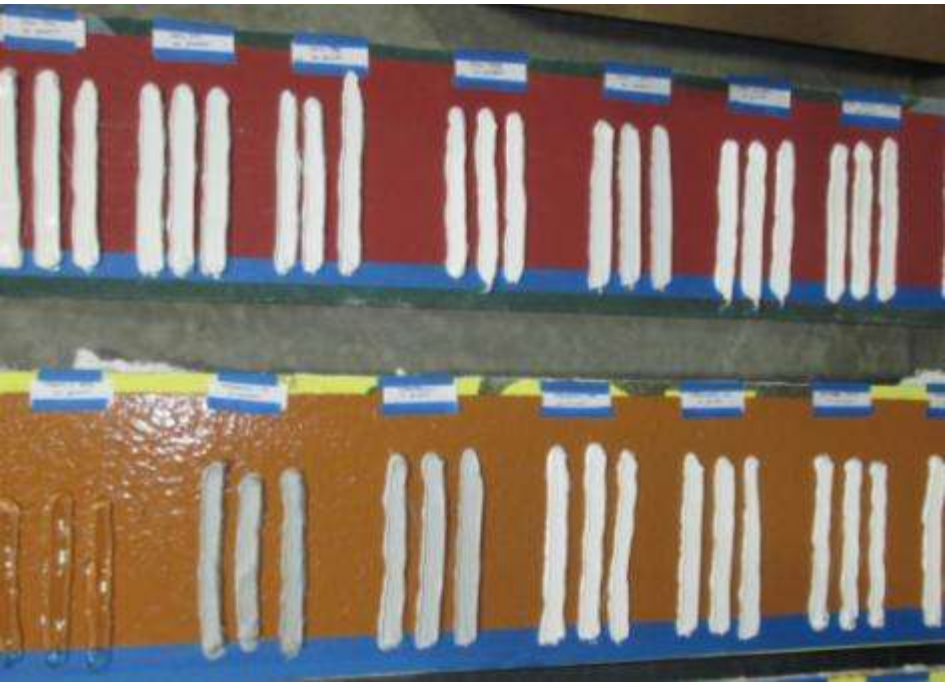
- Test Board Set-up:
  - Prime / No Prime
  - Tooling for proper adhesion

The Test Boards

- Substrate Board Type 1:
  - Weather Resistive Barriers (WRBs)
  - Self Adhered Membranes (SAMs)

The Test Boards

- Substrate Board Type 2:
  - Liquid Applied Membranes

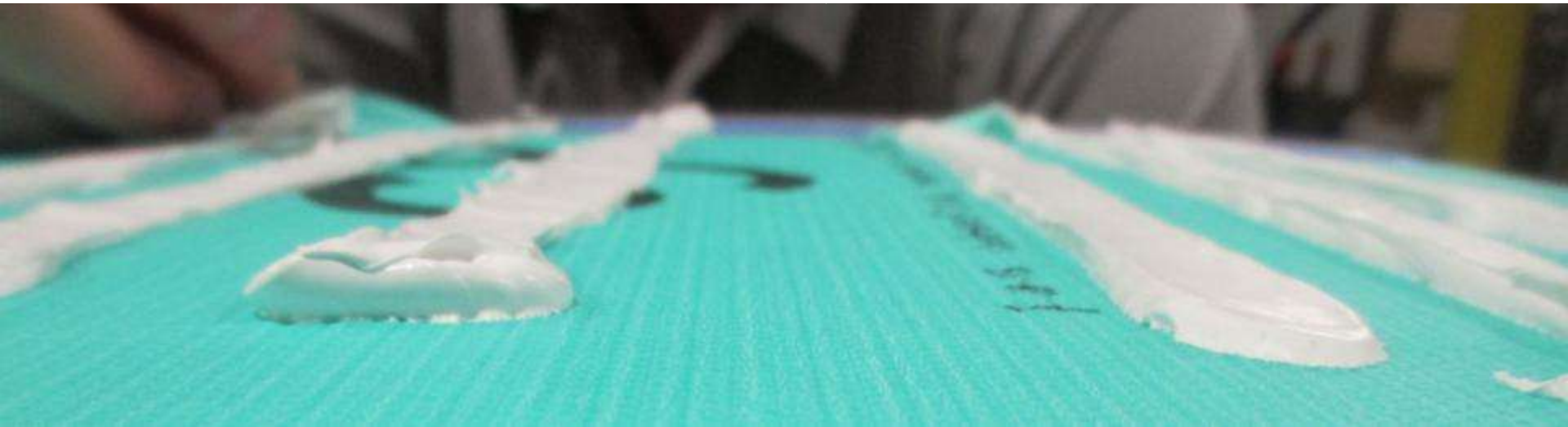


The Test Boards

- Substrate (Non)Board Type 3:
  - Cladding Materials

Sealant Pull Tests

- Pull Tab Preparation:
  - Process
  - Difficulties
  - Changes
    - Thicker beads
    - Thicker tape
    - Implications

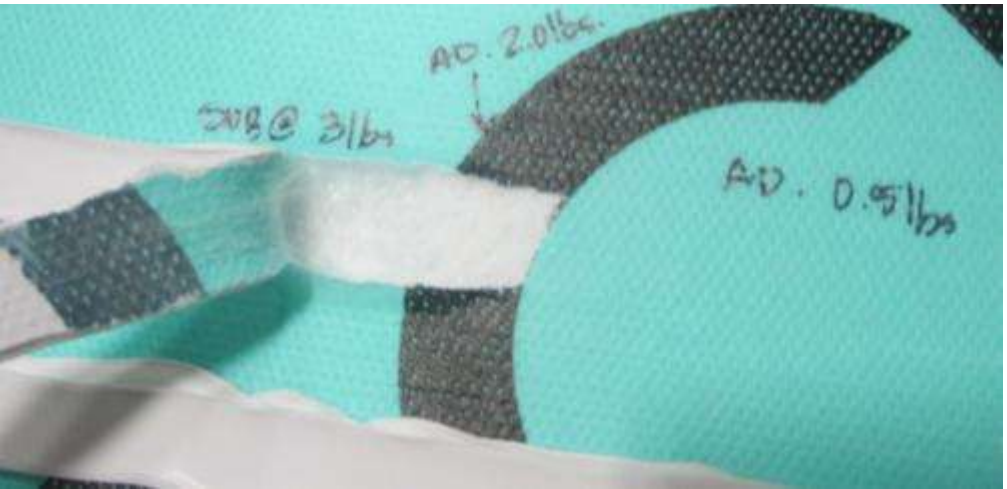


Sealant Pull Tests

- Test Equipment:
  - Vise grips
  - Bond breaker tape
  - Scale - 0 to 11 pounds

Sealant Pull Tests

- Measurements:
  - Resistance
    - 0 to 11 pounds (>11)
  - Modes of Failure
    - Adhesive (AF)
    - Cohesive (CF)
    - Substrate (SF)
    - Liquid Applied (LF*)
    - * liquid applied peeled up from underlying substrate
- Comparative Results
  - Not meant for precise or structural analysis



Results: 7-14 Day Difference - SAMs

- 126 out of 255 (about 50%) sealant to SAM combinations showed **increased** strength from the 7 day pull to the 14 day pull.

silicone

STPe

elastomeric polymer

polyurethane

Increased Strength

No StrengthChange

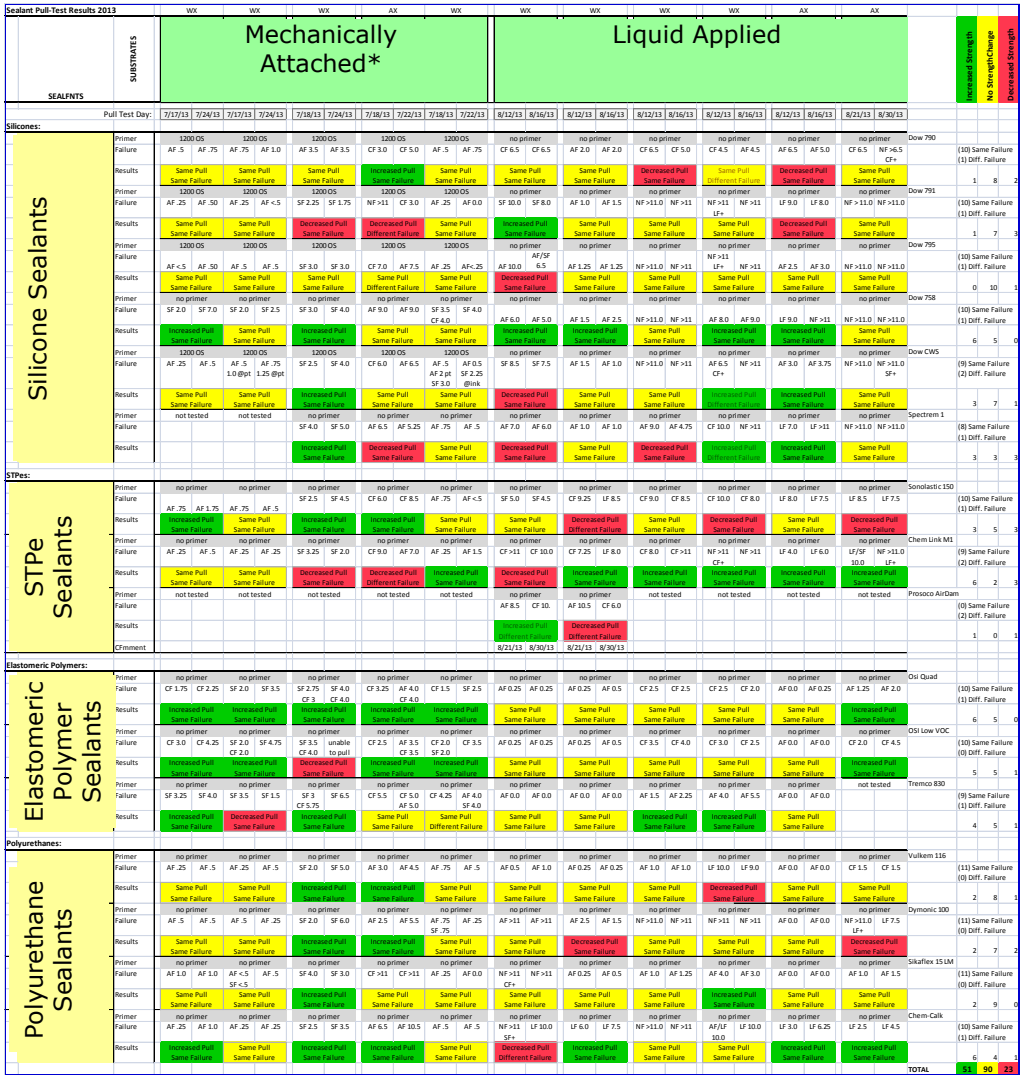
Decreased Strength

Sealant Pull-Test Results 2013

SUBSTRATES / SEALANTS	Pull Test Day:	Increased Strength	No StrengthChange	Decreased Strength
Silicones:				
WX Foil	7/31/13 8/9/13			
Primer	1200 OS			Dow 790
Failure	CF 5.0 CF 7.25 CF 6.25 AF 6.0			(15) Same Failure
Results	Increased Pull Same Failure			(2) Diff. Failure
WX Poly.	7/29/13 8/9/13	8	7	2
Primer	1200 OS			
Failure	CF 4.0 CF 4.25 CF 3.25 CF 4.0			
Results	Same Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	1200 OS			
Failure	CF 4.0 CF 4.25 CF 3.25 CF 4.0			
Results	Same Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	1200 OS			
Failure	CF 4.0 CF 4.25 CF 3.25 CF 4.0			
Results	Same Pull Same Failure			
WX Foil	7/22/13 7/29/13			
Primer	1200 OS			
Failure	AF 3.0 CF 3.0 CF 2.5			
Results	Same Pull Same Failure			
AX Poly.	7/31/13 8/9/13			
Primer	1200 OS			
Failure	CF 5.25 CF 5.75 CF 3.25 CF 5.25			
Results	Same Pull Same Failure			
AX Poly.	7/31/13 8/9/13			
Primer	1200 OS			
Failure	CF 5.25 CF 5.75 CF 3.25 CF 5.25			
Results	Increased Pull Same Failure			
AX Poly.	7/24/13 7/31/13			
Primer	1200 OS			
Failure	AF 2.5 AF 5.25 CF 4.0 CF 4.5			
Results	Increased Pull Same Failure			
AX Poly.	7/24/13 7/31/13			
Primer	1200 OS			
Failure	CF 11.0 CF 9.0 CF 10.0 NF >11			
Results	Decreased Pull Same Failure			
AX Poly.	7/24/13 7/31/13			
Primer	1200 OS			
Failure	AF 2.5 AF 5.25 CF 4.0 CF 4.5			
Results	Increased Pull Same Failure			
AX Foil	7/24/13 7/31/13			
Primer	1200 OS			
Failure	AF 3.25 AF 4.0			
Results	Increased Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	1200 OS			
Failure	CF 9.0 CF 7.5 CF 6.0 CF 5.0			
Results	Decreased Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	1200 OS			
Failure	CF 10.5 NF >11 NF >11 CF 10.25			
Results	Decreased Pull Different Failure			
WX Poly.	7/29/13 8/9/13			
Primer	1200 OS			
Failure	NF >11 CF 4.25 CF 5.5 AF 5.0			
Results	Same Pull Same Failure			
WX Foil	7/29/13 8/9/13			
Primer	1200 OS			
Failure	CF 4.25 CF 5.5 AF+			
Results	Same Pull Same Failure			
WX Poly.	7/24/13 7/31/13			
Primer	1200 OS			
Failure	AF 5.25 AF 5.0 CF 3.0 AF 4.0			
Results	Same Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	1200 OS			
Failure	CF 3.0 AF 4.0			
Results	Different Failure			
WX Poly.	7/22/13 7/29/13			
Primer	1200 OS			
Failure	CF 2.75 CF 4.0 CF 2.5 CF 2.5			
Results	Increased Pull Same Failure			
WX Foil	7/22/13 7/29/13			
Primer	1200 OS			
Failure	CF 2.5 CF 4.0 CF 2.5			
Results	Same Pull Same Failure			
no primer				
WX Foil	7/31/13 8/9/13			
Primer	no primer			Dow 791
Failure	NF 11 NF >11			(12) Same Failure
Results	Same Pull Same Failure			(5) Diff. Failure
WX Poly.	7/31/13 8/9/13	4	9	4
Primer	1200 OS			
Failure	NF >11 CF+ NF >11			
Results	Same Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	1200 OS			
Failure	CF 10.0 AF 6.0 CF 5.5 CF 7.0			
Results	Decreased Pull Different Failure			
WX Poly.	7/22/13 7/29/13			
Primer	1200 OS			
Failure	CF 10.0 AF 6.0 CF 5.5 CF 7.0			
Results	Increased Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	CF >11 CF 3.0 CF 2.5			
Results	Same Pull Same Failure			
AX Poly.	7/31/13 8/9/13			
Primer	1200 OS			
Failure	NF 11 SF+ NF >11			
Results	Same Pull Same Failure			
AX Poly.	7/31/13 8/9/13			
Primer	1200 OS			
Failure	NF 11 SF+ NF >11			
Results	Same Pull Same Failure			
AX Poly.	7/24/13 7/31/13			
Primer	1200 OS			
Failure	CF 11.0 CF 9.0 CF 10.0 NF >11			
Results	Decreased Pull Same Failure			
AX Poly.	7/24/13 7/31/13			
Primer	1200 OS			
Failure	CF 10.0 NF >11 NF >11 CF+			
Results	Increased Pull Different Failure			
AX Poly.	7/24/13 7/31/13			
Primer	1200 OS			
Failure	NF >11 CF+ NF >11 CF+			
Results	Same Pull Same Failure			
AX Foil	7/24/13 7/31/13			
Primer	no primer			
Failure	NF >11 CF+ NF >11 CF+			
Results	Same Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	1200 OS			
Failure	CF 10.5 NF >11 NF >11 CF+			
Results	Increased Pull Different Failure			
WX Poly.	7/29/13 8/9/13			
Primer	1200 OS			
Failure	NF >11 CF+ NF >11 CF 10.25			
Results	Decreased Pull Different Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	NF >11 CF+ NF >11 CF+			
Results	Same Pull Same Failure			
WX Foil	7/29/13 8/9/13			
Primer	1200 OS			
Failure	CF 5.5 AF+			
Results	Same Pull Same Failure			
WX Poly.	7/24/13 7/31/13			
Primer	1200 OS			
Failure	AF 5.25 AF 5.0 CF 3.0 AF 4.0			
Results	Same Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	1200 OS			
Failure	CF 3.0 AF 4.0			
Results	Different Failure			
WX Poly.	7/22/13 7/29/13			
Primer	1200 OS			
Failure	CF 2.75 CF 4.0 CF 2.5 CF 2.5			
Results	Increased Pull Same Failure			
WX Foil	7/22/13 7/29/13			
Primer	1200 OS			
Failure	CF 2.5 CF 4.0 CF 2.5			
Results	Same Pull Same Failure			
no primer				
WX Foil	7/31/13 8/9/13			
Primer	no primer			Dow 795
Failure	CF >11 NF >11 AF + CF 10.75 SF start AF 5.5			(8) Same Failure
Results	Same Pull Different Failure			(9) Diff. Failure
AX Poly.	7/31/13 8/9/13			
Primer	no primer			
Failure	NF >11 NF >11 CF >11 AF 10.5			
Results	Same Pull Same Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	AF 7.25 NF >11 CF 3.5 AF 7.0			
Results	Increased Pull Same Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	AF/CF 5.0 AF/CF 8.0			
Results	Increased Pull Same Failure			
AX Foil	7/24/13 7/31/13			
Primer	no primer			
Failure	NF >11 CF+			
Results	Same Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	NF >11 CF+ NF >11 CF 10 CF >11 AF 8.5			
Results	Same Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	CF 8.5 NF >11 CF+			
Results	Same Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	CF 8.5 NF >11 CF+			
Results	Same Pull Same Failure			
WX Foil	7/29/13 8/9/13			
Primer	no primer			
Failure	CF 5.5 AF+			
Results	Same Pull Same Failure			
WX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	CF 7.5 SF 5.5			
Results	Same Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 7.0 CF 8.5 CF 4.5 AF 4.0			
Results	Different Failure			
WX Foil	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 2.5 CF 4.0 CF 2.5			
Results	Same Pull Same Failure			
Silicones:				
AX Foil	7/31/13 8/9/13			
Primer	no primer			Dow 758
Failure	CF >11 NF 11.0 AF+ CF 8.75 AF 10.25			(10) Same Failure
Results	Same Pull Different Failure			(7) Diff. Failure
AX Poly.	7/31/13 8/9/13			
Primer	no primer			
Failure	CF >11 NF 11.0 AF+ CF 8.75 AF 10.25			
Results	Increased Pull Different Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	AF 6.0 AF 8.0 AF 9.0 AF 10.0			
Results	Increased Pull Same Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	AF 6.5 AF 10.0			
Results	Increased Pull Same Failure			
AX Foil	7/24/13 7/31/13			
Primer	no primer			
Failure	AF 8.0 AF 9.0 AF 10.0			
Results	Increased Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	AF 9.25 CF >11 NF >11 CF+ CF 6.25 AF 10.0			
Results	Same Pull Different Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	NF >11 CF+ NF >11 CF+			
Results	Increased Pull Different Failure			
WX Foil	7/29/13 8/9/13			
Primer	no primer			
Failure	CF 6.25 AF 10.0			
Results	Same Pull Same Failure			
WX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	CF 7.0 SF 6.0 CF 4.25 CF 9.5			
Results	Decreased Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	AF 8.0 AF 6.5 CF 10.5 CF 11.0			
Results	Decreased Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 7.0 CF 8.5 CF 4.5 AF 4.0			
Results	Decreased Pull Same Failure			
WX Foil	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 2.5 CF 4.0 CF 2.5			
Results	Same Pull Same Failure			
STPes:				
AX Foil	7/31/13 8/9/13			
Primer	no primer			Sono 150
Failure	CF 6.5 CF/AF 8.5 CF 7.25 CF 11.0			(14) Same Failure
Results	Increased Pull Same Failure			(3) Diff. Failure
AX Poly.	7/31/13 8/9/13			
Primer	no primer			
Failure	CF 6.5 CF/AF 8.5 CF 7.25 CF 11.0			
Results	Increased Pull Same Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	AF/CF 5.75 AF/CF 7.0 CF 7.0 CF 10.25 CF 6.75 CF 8.5			
Results	Increased Pull Same Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	CF >11 CF/AF 7.5 CF 10.0 CF 10.5 CF 8.0 CF >11			
Results	Same Pull Same Failure			
AX Foil	7/24/13 7/31/13			
Primer	no primer			
Failure	AF 7.5 CF 7.5 NF >11 AF 8.5 AF 6.0 AF 9.0			
Results	Same Pull Different Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	NF >11 CF+ CF 11.0 CF 6.0 CF 8.0 CF 10.0 CF 8.75 CF 8.5			
Results	Same Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	CF 8.75 AF 10.0 AF/CF 9.5 CF 10.5 NF 11.0 CF+ CF 11.0			
Results	Increased Pull Same Failure			
WX Foil	7/29/13 8/9/13			
Primer	no primer			
Failure	AF 7.25 NF >11 AF/CF+ AF 7.0 AF 10 NF 10.0 CF+ AF 7.5			
Results	Increased Pull Same Failure			
WX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	AF 6.5 SF 6.5 SF 7.0			
Results	Same Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 9.0 AF 3.5 CF 4.0 CF 9.5			
Results	Same Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 10 CF 9.0 CF 7.0 CF 7.0			
Results	Same Pull Same Failure			
WX Foil	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 5.0 CF 5.0 AF 4.75 CF 3.25 AF 4.0			
Results	Same Pull Same Failure			
Elastomeric Polymers:				
AX Foil	7/31/13 8/9/13			
Primer	no primer			OSI Quad
Failure	AF 4.5 AF 3.5 AF 4.0 CF 2.5			(16) Same Failure
Results	Decreased Pull Same Failure			(1) Diff. Failure
AX Poly.	7/31/13 8/9/13			
Primer	no primer			
Failure	CF 6.5 CF/AF 7.5 CF 7.25 CF 11.0			
Results	Decreased Pull Different Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	CF 1.5 CF 1.25 CF 2.0 CF 3.5 CF .5 CF 3.0			
Results	Same Pull Same Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	CF .25 CF 2.5 CF 1.0 CF 2.75 CF 1.0 CF 4.25			
Results	Increased Pull Same Failure			
AX Foil	7/24/13 7/31/13			
Primer	no primer			
Failure	CF 1.5 CF 6.5 CF 1.75 CF 7.25 CF 2.0 CF 4.5			
Results	Increased Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	CF 3.0 CF 2.0 CF 0.5 CF 3.5 CF 1.25 CF 2.0			
Results	Decreased Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	CF 2.0 CF 1.0 too soft to pull CF 2.0 too soft to pull CF 0.5			
Results	Decreased Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	CF 1.5 CF 6.0 CF 2.0 CF 2.5			
Results	Increased Pull Same Failure			
WX Foil	7/29/13 8/9/13			
Primer	no primer			
Failure	CF 1.75 CF 3.0 CF 2.0 CF 2.5			
Results	Increased Pull Same Failure			
WX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	CF 2.0 AF 2.75 CF start CF 2.5 CF 3.5			
Results	Increased Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 2.0 CF 3.0 CF 2.5 CF 3.0			
Results	Increased Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 2.0 AF 2.5 CF2.5 CF/CF 2.25 AF 2.5 AF 3.0			
Results	Same Pull Same Failure			
WX Foil	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 2.5 CF 4.0 CF 2.5 CF 2.5			
Results	Same Pull Same Failure			
Polyurethanes:				
AX Foil	7/31/13 8/9/13			
Primer	no primer			Vulkem 116
Failure	AF 6.0 AF 4.25 AF 5.0 AF 8.0			(15) Same Failure
Results	Decreased Pull Same Failure			(2) Diff. Failure
AX Poly.	7/31/13 8/9/13			
Primer	no primer			
Failure	NF >11 less at ink NF >11 AF at ink NF 11 SF+ SF 10.0			
Results	Increased Pull Different Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	NF >11 AF 6.5 NF >11 NF >11 AF 4.0 AF 6.5			
Results	Decreased Pull Different Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	NF >11 CF 3.75 CF 4.0 CF 2.5			
Results	Same Pull Same Failure			
AX Foil	7/24/13 7/31/13			
Primer	no primer			
Failure	NF >11 AF 4.0 AF 6.5			
Results	Increased Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	AF 9.0 varies w/ ink AF 9.5 NF >11 AF+ NF >11 AF+ AF 3.0 AF 3.0			
Results	Same Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	NF >11 AF+ NF >11 NF >11 AF 2.25 AF 2.75			
Results	Same Pull Same Failure			
WX Foil	7/29/13 8/9/13			
Primer	no primer			
Failure	NF >11 NF >11 NF >11 NF >11			
Results	Same Pull Same Failure			
WX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	SF 5.25 SF 7.0 AF/CF SUB 8.0 NF 11 SF start			
Results	Increased Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	SF 6.5 CF 6.5 CF 8.0 SF at tab AF 2.0 AF 2.5			
Results	Increased Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 11.25 SF 9.5 AF 3.0 AF 2.5			
Results	Decreased Pull Different Failure			
WX Foil	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 3.5 CF 4.75 CF 3.0 AF 3.5			
Results	Same Pull Different Failure			
no primer				
WX Foil	7/31/13 8/9/13			
Primer	no primer			Dymonic 100
Failure	AF 4.0 AF 4.25 NF >11 SF/CF + NF >11			(13) Same Failure
Results	Same Pull Same Failure			(4) Diff. Failure
AX Poly.	7/31/13 8/9/13			
Primer	no primer			
Failure	NF >11 NF >11 AF at ink SF 10 SF 10.5			
Results	Same Pull Same Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	NF >11 NF >11 NF >11 NF >11 AF 3.25 AF 2.0			
Results	Decreased Pull Different Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	NF >11 NF >11 NF >11 CF+ NF >11 AF 11.0 NF >11			
Results	Same Pull Same Failure			
AX Foil	7/24/13 7/31/13			
Primer	no primer			
Failure	AF 10.25 1/2bd NF >11 AF >11 AF 11 AF 11.0 CF 11.0 NF >11 CF+			
Results	Increased Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	NF >11 AF+ NF >11 NF >11 AF 4.5 AF 7.0 varies w ink AF 10.5 AF >11 AF 3.25 AF 7.25			
Results	Increased Pull Different Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	NF >11 AF/CF + NF >11 AF+ NF 11.0 CF+ NF >11			
Results	Same Pull Same Failure			
WX Foil	7/29/13 8/9/13			
Primer	no primer			
Failure	AF 9.75 NF >11			
Results	Increased Pull Different Failure			
WX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	SF 7.25 SF 6.0 AF 9.0 SF 9.0			
Results	Decreased Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 11.0 CF 8.5 AF 9.0 CF 5.0 AF 5.0			
Results	Decreased Pull Same Failure			
WX Foil	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 11.0 CF 8.5 AF 9.0 CF 5.0 AF 5.0			
Results	Same Pull Same Failure			
no primer				
WX Foil	7/31/13 8/9/13			
Primer	no primer			Sikaflex 15LM
Failure	AF 11 NF >11 AF/CF+ AF 11.0 NF >11 CF+			(9) Same Failure
Results	Same Pull Same Failure			(8) Diff. Failure
AX Poly.	7/31/13 8/9/13			
Primer	no primer			
Failure	NF >11 AF 10.75 at ink SF 11 SF+ SF 10.0			
Results	Same Pull Different Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	NF >11 NF >11 NF >11 CF+ NF >11 AF 11.0 NF >11			
Results	Same Pull Same Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	AF 5.5 NF 11 CF+ AF 5.25 CF >11 AF 8.0 NF 11.0 CF+			
Results	Increased Pull Different Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	AF 5.25 CF >11 AF 8.0 NF 11.0 CF+			
Results	Increased Pull Different Failure			
AX Foil	7/24/13 7/31/13			
Primer	no primer			
Failure	AF 3.75 CF 3.75 CF >11 AF 3.0 CF 2.5			
Results	Same Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	CF 10.5 NF >11 NF >11 CF+ CF 10.25 NF >11 NF >11 CF+			
Results	Same Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	NF >11 CF+ CF 10 CF >11 CF 8.5 NF >11 CF/AF+			
Results	Same Pull Same Failure			
WX Foil	7/29/13 8/9/13			
Primer	no primer			
Failure	CF 10 CF >11 CF 8.5 NF >11 CF/AF+			
Results	Same Pull Same Failure			
WX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	AF 5.5 CF 5.5 AF 6.0 CF 4.25 CF 9.5			
Results	Same Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 7.0 CF 8.5 CF 4.5 AF 6.0			
Results	Increased Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 9.0 AF 10.0 AF 4.25 AF 5.0			
Results	Same Pull Same Failure			
WX Foil	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 2.5 CF 4.0 CF 2.5			
Results	Same Pull Same Failure			
no primer				
WX Foil	7/31/13 8/9/13			
Primer	no primer			ChemCalk
Failure	NF >11 NF >11 AF 6.0 AF 5.25			(11) Same Failure
Results	Same Pull Same Failure			(5) Diff. Failure
AX Poly.	7/31/13 8/9/13			
Primer	no primer			
Failure	CF 7.25 CF 7.5 AF 4.5 SF 10.25 CF 11.0 AF 10.5			
Results	Same Pull Same Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	NF >11 AF 10.75 at ink SF 8.5 SF 9.0			
Results	Same Pull Different Failure			
AX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	AF 11.0 NF >11 CF 11.0 CF+			
Results	Same Pull Same Failure			
AX Foil	7/24/13 7/31/13			
Primer	no primer			
Failure	NF >11 NF >11 AF 10.0 SF 10.5			
Results	Same Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	NF >11 NF >11 AF/CF + NF >11 AF+ NF 11.0 CF+ NF >11			
Results	Same Pull Same Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	AF 4.5 AF 7.0 varies w ink AF 10.5 AF >11 AF 3.25 AF 7.25			
Results	Increased Pull Different Failure			
WX Poly.	7/29/13 8/9/13			
Primer	no primer			
Failure	NF >11 AF+ NF >11 NF >11 AF 2.25 AF 2.75			
Results	Same Pull Same Failure			
WX Foil	7/29/13 8/9/13			
Primer	no primer			
Failure	CF 5.5 AF+ NF >11 CF+			
Results	Same Pull Same Failure			
WX Poly.	7/24/13 7/31/13			
Primer	no primer			
Failure	AF 5.25 AF 5.0 CF 3.0 AF 4.0			
Results	Same Pull Same Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 3.0 AF 4.0			
Results	Different Failure			
WX Poly.	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 2.75 CF 4.0 CF 2.5 CF 2.5			
Results	Increased Pull Same Failure			
WX Foil	7/22/13 7/29/13			
Primer	no primer			
Failure	CF 2.5 CF 4.0 CF 2.5			
Results	Same Pull Same Failure			
	TOTAL	126	84	45

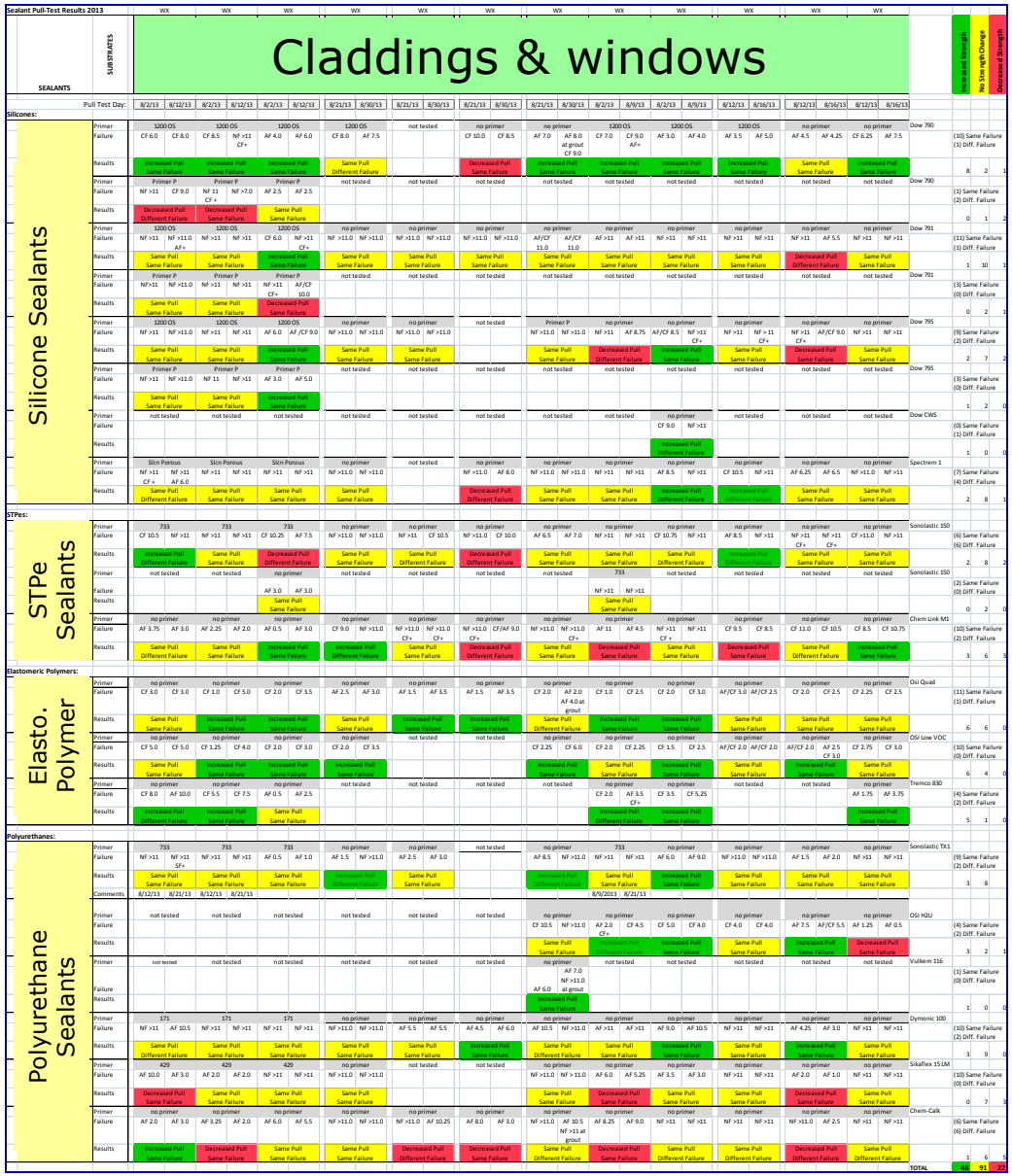
Results: 7-14 Day Difference - WRBs

- 51 out of 164 (about 31%) sealant to WRB combinations showed **increased** strength from the 7 day pull to the 14 day pull.
- 90 out of 164 (about 55%) sealant to WRB combinations showed **no significant difference** strength from the 7 day pull to the 14 day pull.



Results: 7-14 Day Difference - Claddings

- 48 out of 161 (about 30%) sealant to Cladding combinations showed **increased** strength from the 7 day pull to the 14 day pull.
- 91 out of 161 (about 57%) sealant to Cladding combinations showed **no significant difference** in the strength from the 7 day pull to the 14 day pull.



Increased Strength
No StrengthChange
Decreased Strength

Results: Recorded Pull Strengths

- Comparative Range of Pull Strengths
  - 0 to <3 lbs.
  - 3 to <6 lbs.
  - 6 to <9 lbs.
  - 9 to 11 lbs.

Color Scale:
0 to <3
3 to <6
6 to <9
9 to 11

- Consider the Sealants' "Properties"
  - Manufacturers' performance specification
  - Design expectations

- Material Variances
  - Substrate type, properties, and chemistry

Results: Pull Strengths - SAMs

- Polyurethanes exhibited high pull strengths more consistently on SAMs. The STPe and Silicone sealants were very close behind.
- All of the Elastomeric Polymers had relatively low adhesion to all the SAMs, regardless of facing material (polyethylene or foil).

Sealant Pull-Test Results 2013

SEALANTS / SUBSTRATES: Self-Adhered Membranes (SAMs) Foil & Polyethylene Faced

SEALANTS		WX		WX	
Pull Test Day:		7/31/13	8/9/13	7/29/13	8/9/13
Silicones:					
Silicone Sealants	Primer	1200 OS		1200 OS	
	Failure	CO 5.0	CO 7.25	CO 6.25	AD 6.0
	Primer	no primer		1200 OS	
	Failure	NF 11	NF >11	NF >11 CO+	NF >11
	no primer	no primer		1200 OS	
	Failure	CO >11	NF >11 AD +	CO 10.75 SB start	AD 5.5
	no primer	no primer		no primer	
	Failure	CO 9.25	NF >11.0	CO 6.5	AD 9.0
	Primer	no primer		1200 OS	
	Failure	NF >11	NF >11 CO+	AD 8.5	CO 9.5
	Primer	no primer		no primer	
	Failure	AD 7.5	AD 10.0	AD 7.5	AD 5.0
STPes:					
STPe Sealants	Primer	no primer		no primer	
	Failure	CO 6.25	NF >11.0	CO 8.25	CO 8.5
	Primer	no primer		no primer	
	Failure	NF >11	NF >11	CO 7.0	AD 2.5
Elastomeric Polymers:					
Elasto. Polymer Sealants	Primer	no primer		no primer	
	Failure	CO 5.25	CO 3.25	CO 3.25	AD 6.0 CO+
	Primer	no primer		no primer	
	Failure	CO 5.0	CO 3.0	too soft to pull	CO 1.25
	Primer	no primer		no primer	
	Failure	AD 3.75	AD 4.25	CO 2.0	AD/CO 6.0+
Polyurethanes:					
Polyurethane Sealants	Primer	no primer		no primer	
	Failure	AD 6.0	AD 4.25	AD 5.0	AD 8.0
	Primer	no primer		no primer	
	Failure	AD 4.0	AD 4.25	NF >11 SB/CO +	NF >11
	Primer	no primer		no primer	
	Failure	AD 11	NF >11 AD/CO+	AD 11.0	NF >11 CO+
	Primer	no primer		no primer	
	Failure	NF >11	NF >11	AD 6.0	AD 5.25

SEALANTS		WX		WX		WX	
Pull Test Day:		7/22/13	7/29/13	7/22/13	7/29/13	7/22/13	7/29/13
Silicones:							
Silicone Sealants	Primer	1200 OS		1200 OS		1200 OS	
	Failure	CO 4.0	CO 4.25	CO 3.25	CO 4.0	AD 3.0 CO 3.0	CO 2.5
	Primer	1200 OS		1200 OS		no primer	
	Failure	CO 10.0	AD 6.0	CO 5.5	CO 7.0	CO >11	CO >11
	no primer	1200 OS		1200 OS		no primer	
	Failure	CO 5.0	AD 6.0	CO 6.5	CO 8.0	CO 6.0	CO 9.0
	no primer	no primer		no primer		no primer	
	Failure	AD 5.5 CO 5.5	AD 6.0	AD 4.25	AD 8.5	CO 6.0	CO 10 AD start
	Primer	1200 OS		1200 OS		no primer	
	Failure	AD 5.0 CO 5.0	AD 7.0	AD 7.0	CO 8.0	CO 4.0	AD 6.0
	Primer	no primer		no primer		no primer	
	Failure	AD 7.0	AD 6.0	CO 9.5	AD 7.0	CO 5.0	AD 6.0
STPes:							
STPe Sealants	Primer	no primer		no primer		no primer	
	Failure	AD 8.5	CO 7.75	CO 3.5	CO 6.0	CO 7.0	CO 8.5
	Primer	no primer		no primer		no primer	
	Failure	CO 11.0	CO 10.0	CO 5.5	CO 6.0	CO 8.5	CO 11.0
Elastomeric Polymers:							
Elasto. Polymer Sealants	Primer	no primer		no primer		no primer	
	Failure	CO 1.25	CO 3.0	CO 3.0	CO 2.5	CO 2.0	CO 2.0
	Primer	no primer		no primer		no primer	
	Failure	CO 2.25	CO 3.0	CO 3.0	CO 1.75	CO 1.0	CO 3.0
	Primer	no primer		no primer		no primer	
	Failure	CO 3.25	CO 5.25	AD 3.75	CO 5.0	CO 2.5	CO 4.0
Polyurethanes:							
Polyurethane Sealants	Primer	no primer		no primer		no primer	
	Failure	CO >11	CO 9.5	AD 3.75 CO 3.75	CO >11	AD 3.0	AD 4.0
	Primer	no primer		no primer		no primer	
	Failure	CO >11	NF 11 CO+	CO 6.25	SB/AD 10.0	AD 1.5	AD 4.0
	Primer	no primer		no primer		no primer	
	Failure	AD 5.5	NF 11 CO +	AD 5.25	CO >11	AD 8.0	NF 11.0 CO +
	Primer	no primer		no primer		no primer	
	Failure	CO 7.25	CO 7.5	AD 4.5	SB 10.25	CO 11.0	AD 10.5

SEALANTS		AX		AX	
Pull Test Day:		7/31/13	8/9/13	7/31/13	8/9/13
Silicones:					
Silicone Sealants	Primer	1200 OS		1200 OS	
	Failure	CO 5.25	CO 5.75	CO 3.25	CO 5.25
	Primer	1200 OS		1200 OS	
	Failure	NF 11 SB +	NF >11	NF 11 SB +	NF >11
	no primer	1200 OS		1200 OS	
	Failure	NF >11	NF >11	CO >11	AD 10.5
	no primer	no primer		no primer	
	Failure	CO >11	NF 11.0 AD+	CO 8.75	AD 10.25
	Primer	1200 OS		1200 OS	
	Failure	AD/SB >11	AD 10.0	CO 10	SB 10.0
	Primer	no primer		no primer	
	Failure	AD 6.75	AD 8.0	CO 6.25	AD 10.0
STPes:					
STPe Sealants	Primer	no primer		no primer	
	Failure	CO 6.5	CO/AD 8.5	CO 7.25	CO 11.0
	Primer	no primer		no primer	
	Failure	CO 8.75	CO 10.5	CO 9.0	CO >11.0
Elastomeric Polymers:					
Elasto. Polymer Sealants	Primer	no primer		no primer	
	Failure	AD 4.5	AD 3.5	AD 4.0	CO 2.5
	Primer	no primer		no primer	
	Failure	CO 3.0	CO 2.0	CO 2.5	AD/CO 2.0
	Primer	no primer		no primer	
	Failure	CO 4.5	CO 6.0	CO 5.0	SB/AD 6.5
Polyurethanes:					
Polyurethane Sealants	Primer	no primer		no primer	
	Failure	NF >11 less at ink	NF >11 AD at ink	NF 11 SB +	SB 10.0
	Primer	no primer		no primer	
	Failure	NF >11	NF >11 AD at ink	SB 10	SB 10.5
	Primer	no primer		no primer	
	Failure	NF >11	AD 10.75 at ink	NF 11 SB +	SB 10.0
	Primer	no primer		no primer	
	Failure	NF >11	AD	SB 8.5	SB 9.0

SEALANTS		AX		AX		AX	
Pull Test Day:		7/24/13	7/31/13	7/24/13	7/31/13	7/24/13	7/31/13
Silicones:							
Silicone Sealants	Primer	1200 OS		1200 OS		1200 OS	
	Failure	AD 2.5	AD 5.25	CO 4.0	CO 4.5	AD 3.25	AD 4.0
	Primer	1200 OS		1200 OS		no primer	
	Failure	CO 11.0	CO 9.0	CO 10.0	NF >11	NF >11 CO +	NF >11
	no primer	1200 OS		1200 OS		no primer	
	Failure	AD 7.25	NF >11	CO 3.5	AD 7.0	AD/CO 5.0	AD/CO 8.0
	no primer	no primer		no primer		no primer	
	Failure	AD 6.0	AD 8.0	AD 9.0	AD 10.0	AD 6.5	AD 10.0
	Primer	1200 OS		1200 OS		no primer	
	Failure	CO 6.25	CO 9.5	AD 7.0 CO 7.0	AD 9.25	AD 8.0	AD 5.5
	Primer	no primer		no primer		no primer	
	Failure	AD 7.5	CO 7.5	NF >11	AD 8.5	AD 6.0	AD 9.0
STPes:							
STPe Sealants	Primer	no primer		no primer		no primer	
	Failure	AD/CO 5.75	AD/CO 7.0	CO 7.0	CO 10.25	CO 6.75	CO 8.5
	Primer	no primer		no primer		no primer	
	Failure	CO >11	CO >11	CO 10.0	CO 10.5	CO 8.0	CO >11
Elastomeric Polymers:							
Elasto. Polymer Sealants	Primer	no primer		no primer		no primer	
	Failure	CO 1.5	CO 1.25	CO 2.0	CO 3.5	CO .5	CO 3.0
	Primer	no primer		no primer		no primer	
	Failure	CO .25	CO 2.5	CO 1.0	CO 2.75	CO 1.0	CO 4.25
	Primer	no primer		no primer		no primer	
	Failure	CO 1.5	CO 6.5	CO 1.75	CO 7.25	CO 2.0	CO 4.5
Polyurethanes:							
Polyurethane Sealants	Primer	no primer		no primer		no primer	
	Failure	NF >11	AD 6.5	NF >11	NF >11	AD 4.0	AD 6.5
	Primer	no primer		no primer		no primer	
	Failure	NF >11	NF >11	NF >11	NF >11	AD 3.25	AD 2.0
	Primer	no primer		no primer		no primer	
	Failure	NF >11	NF >11	NF >11 CO+	NF >11	AD 11.0	NF >11
	Primer	no primer		no primer		no primer	
	Failure	AD 10.25 1/2 bead	NF >11	AD >11	AD 11	AD 11.0 CO 11.0	NF >11 CO+

SEALANTS		WX		WX		WX	
Pull Test Day:		7/29/13	8/9/13	7/29/13	8/9/13	7/29/13	8/9/13
Silicones:							
Silicone Sealants	Primer	1200 OS		1200 OS		1200 OS	
	Failure	CO 9.0	CO 7.5	CO 6.0	CO 5.0	CO 4.25	CO 5.5 AD +
	Primer	1200 OS		1200 OS		no primer	
	Failure	CO 10.5	NF >11	NF >11 CO +	CO 10.25	NF > 11	NF >11 CO +
	no primer	1200 OS		1200 OS		no primer	
	Failure	NF >11 CO +	NF >11	CO 10	CO >11	CO 8.5	NF >11 CO/AD +
	no primer	no primer		no primer		no primer	
	Failure	AD 9.25	CO >11	NF >11 CO+	NF >11 CO+	CO 6.25	AD 10.0
	Primer	1200 OS		1200 OS		no primer	
	Failure	NF >11 CO +	AD 6.5	NF >11	NF >11 CO+	NF >11	NF >11
	Primer	no primer		no primer		no primer	
	Failure	AD 7.25	NF >11 AD/CO+	AD 7.0	AD 10.	NF 10.0 CO +	AD 7.5
STPes:							
STPe Sealants	Primer	no primer		no primer		no primer	
	Failure	NF >11 CO +	CO 11.0	CO 6.0	CO 8.0	CO 8.0	CO 10.5
	Primer	no primer		no primer		no primer	
	Failure	CO 8.75	AD 10.0 CO+	AD/CO 9.5	CO 10.5	NF 11.0 CO +	CO 11.0
Elastomeric Polymers:							
Elasto. Polymer Sealants	Primer	no primer		no primer		no primer	
	Failure	CO 3.0	CO 2.0	CO 0.5	CO 3.5	CO 1.25	CO 2.0
	Primer	no primer		no primer		no primer	
	Failure	CO 2.0	CO 1.0	too soft to pull	CO 2.0	too soft to pull	CO 0.5
	Primer	no primer		no primer		no primer	
	Failure	CO 1.5	CO 4.25	CO 1.0	CO/AD 4.0	CO 1.0	CO 1.25
Polyurethanes:							
Polyurethane Sealants	Primer	no primer		no primer		no primer	
	Failure	AD 9.0 varies w/ ink	AD 9.5	NF >11 AD+	NF >11 AD+	AD 3.0	AD 3.0
	Primer	no primer		no primer		no primer	
	Failure	NF >11 AD +	NF >11	NF >11	NF >11	AD 2.25	AD 2.75
	Primer	no primer		no primer		no primer	
	Failure	AD 4.5	AD 7.0 varies w ink	AD 10.5	AD >11	AD 3.25	AD 7.25
	Primer	no primer		no primer		no primer	
	Failure	AD 9.75	NF >11	NF >11 AD/CO +	NF >11 AD+	NF 11.0 CO+	NF >11

SEALANTS		WX		WX	
Pull Test Day:		7/24/13	7/31/13	7/22/13	7/29/13
Silicones:					
Silicone Sealants	Primer	1200 OS		1200 OS	
	Failure	AD 5.25	AD 5.0	CO 3.0	AD 4.0
	Primer	1200 OS		1200 OS	
	Failure	SB 6.0	SB 2.5	AD 5.5 SB 5.5	AD 6.0
	no primer	1200 OS		1200 OS	
	Failure	CO >11 SB 5.0	SB 8.0	AD 4.25	AD 5.0
	no primer	no primer		no primer	
	Failure	CO 7.0	SB 6.0	CO 4.25	CO 9.5
	Primer	1200 OS		1200 OS	
	Failure	SB 5.5	SB 9.0	AD 4.25	AD 5.0
	Primer	no primer		no primer	
	Failure	NF >11 AD +	NF >11	CO 7.5	CO 8.0
STPes:					
STPe Sealants	Primer	no primer		no primer	
	Failure	CO 9.0	SB 3.5	CO 4.0	CO 9.5
	Primer	no primer		no primer	
	Failure	SB 4.0	SB 6.5	AD 6.0 SB 6.25	SB 7.0
Elastomeric Polymers:					
Elasto. Polymer Sealants	Primer	no primer		no primer	
	Failure	CO 1.75	CO 3.0	CO 2.0	CO 2.5
	Primer	no primer		no primer	
	Failure	CO 1.5	CO 6.0	CO 2.0	CO 2.5
	Primer	no primer		no primer	
	Failure	CO 2.0	CO 1.0	AD 3.0	CO 6.0
Polyurethanes:					
Polyurethane Sealants	Primer	no primer		no primer	
	Failure	SB 5.25	SB 7.0	AD/CO SUB 8.0	NF 11 SB start
	Primer	no primer		no primer	
	Failure	SB 6.5	NF >11	SB >11	NF 11
	Primer	no primer		no primer	
	Failure	SB 3.75	SB >11	CO >11	CO 10.5
	Primer	no primer		no primer	
	Failure	SB 7.25	SB 6.0	AD 9.0	SB 9.0

SEALANTS		WX		WX	
Pull Test Day:		7/22/13	7/29/13	7/19/13	7/22/13
Silicones:					
Silicone Sealants	Primer	1200 OS		1200 OS	
	Failure	CO 2.75	CO 4.0	CO 2.5	CO 2.5
	Primer	1200 OS		no primer	
	Failure	CO 7.0	CO 8.5	CO 4.5	AD 4.0
	no primer	1200 OS		no primer	
	Failure	AD 5.0	CO 7.0	CO 8.0	AD 8.0
	no primer	no primer		no primer	
	Failure	AD 8.0	AD 6.5	CO >11	CO 7.5
	Primer	1200 OS		no primer	
	Failure	CO 5.0	AD 6.0	AD 11	CO 7.5
	Primer	no primer		no primer	
	Failure	CO 5.0	AD 4.75 CO start	CO 3.25	AD 4.0
STPes:					
STPe Sealants	Primer	no primer		no primer	
	Failure	CO 5.0	CO 5.0 AD 4.75	CO 2.5	CO 3.0
	Primer	no primer		no primer	
	Failure	CO 10	CO 9.0	CO 7.0	CO 7.0
Elastomeric Polymers:					
Elasto. Polymer Sealants	Primer	no primer		no primer	
	Failure	CO 2.0	AD 2.75 CO start	CO 2.5	CO 3.5
	Primer	no primer		no primer	
	Failure	AD 2.0 CO2.5	AD/CO 2.25	CO 2.5 AD 2.5	AD 3.0
	Primer	no primer		no primer	
	Failure	CO 3.5 AD 3.5	CO 4.75	CO 3.0	AD 3.5
Polyurethanes:					
Polyurethane Sealants	Primer	no primer		no primer	
	Failure	SB 6.5 CO 6.5	CO 8.0 SB at tab	AD 2.0	AD 2.5
	Primer	no primer		no primer	
	Failure	CO 11.25	SB 9.5	AD 3.0	AD 2.5
	Primer	no primer		no primer	
	Failure	CO 10	SB 9.0 AD 11.0	AD 10.5	AD 7.5
	Primer	no primer		no primer	
	Failure	CO 11.0	CO 8.5	AD 9.0	CO 5.0 AD 5.0

Results: Pull Strengths - SAMs

- Of all the materials tested, generally, sealants did not adhere better to **foil faced SAMs** than the **polyethylene faced SAMs**.
  - Patterns can be seen with sealant types, manufacturer product lines, etc.

Sealant Pull-Test Results 2013

SEALANTS	SUBSTRATES	Foil Faced SAMs										Polyethylene Faced SAMs																					
		WX		WX		AX		WX		WX		WX		WX		WX		AX		AX		AX		AX		WX		WX		WX		WX	
	Pull Test Day:	7/31/13	8/9/13	7/22/13	7/29/13	7/24/13	7/31/13	7/29/13	8/9/13	7/19/13	7/22/13	7/29/13	8/9/13	7/22/13	7/29/13	7/22/13	7/29/13	7/31/13	8/9/13	7/31/13	8/9/13	7/24/13	7/31/13	7/24/13	7/31/13	7/29/13	8/9/13	7/29/13	8/9/13	7/24/13	7/31/13	7/22/13	7/29/13	7/22/13	7/29/13
Silicones:																																	
Silicone Sealants	Primer	1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS	
	Failure	CF 5.0	CF 7.25	AF 3.0 CF 3.0	CF 2.5	AF 3.25	AF 4.0	CF 4.25	CF 5.5 AF +	CF 2.5	CF 2.5	CF 6.25	AF 6.0	CF 4.0	CF 4.25	CF 3.25	CF 4.0	CF 5.25	CF 5.75	CF 3.25	CF 5.25	AF 2.5	AF 5.25	CF 4.0	CF 4.5	CF 9.0	CF 7.5	CF 6.0	CF 5.0	AF 5.25	AF 5.0	CF 3.0	AF 4.0	CF 2.75	CF 4.0
	Primer	no primer		no primer		no primer		no primer		no primer		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS	
	Failure	NF 11	NF >11	CF >11	CF >11	NF >11 CF +	NF >11	NF > 11	NF >11 CF +	CF 4.5	AF 4.0	NF >11 CF+	NF >11	CF 10.0	AF 6.0	CF 5.5	CF 7.0	NF 11 SF +	NF >11	NF 11 SF +	NF >11	CF 11.0	CF 9.0	CF 10.0	NF >11	CF 10.5	NF >11	NF >11 CF +	CF 10.25	SF 6.0	SF 2.5	AF 5.5 SF 5.5	AF 6.0	CF 7.0	CF 8.5
	no primer	no primer		no primer		no primer		no primer		no primer		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS	
	Failure	CF >11	NF >11 AF +	CF 6.0	CF 9.0	AF/CF 5.0	AF/CF 8.0	CF 8.5	NF >11 CF/AF +	CF 8.0	AF 8.0	CF 10.75 SF start	AF 5.5	CF 5.0	AF 6.0	CF 6.5	CF 8.0	NF >11	NF >11	CF >11	AF 10.5	AF 7.25	NF >11	CF 3.5	AF 7.0	NF >11 CF +	NF >11	CF 10	CF >11	CF >11 SF 5.0	SF 8.0	AF 4.25	AF 5.0	AF 5.0	CF 7.0
	no primer	no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer	
	Failure	CF 9.25	NF >11.0	CF 6.0	CF 10 AF start	AF 6.5	AF 10.0	CF 6.25	AF 10.0	CF >11	CF 7.5	CF 6.5	AF 9.0	AF 5.5 CF 5.5	AF 6.0	AF 4.25	AF 8.5	CF >11	NF 11.0 AF+	CF 8.75	AF 10.25	AF 6.0	AF 8.0	AF 9.0	AF 10.0	AF 9.25	CF >11	NF >11 CF+	NF >11 CF+	CF 7.0	SF 6.0	CF 4.25	CF 9.5	AF 8.0	AF 6.5
	Primer	no primer		no primer		no primer		no primer		no primer		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS	
	Failure	NF >11	NF >11 CF+	CF 4.0	AF 6.0	AF 8.0	AF 5.5	NF >11	NF >11	AF 11	CF 7.5	AF 8.5	CF 9.5	AF 5.0 CF 5.0	AF 7.0	AF 7.0	CF 8.0	AF/SF >11	AF 10.0	CF 10	SF 10.0	CF 6.25	CF 9.5	AF 7.0 CF 7.0	AF 9.25	NF >11 CF +	AF 6.5	NF >11	NF >11 CF+	SF 5.5	SF 9.0	AF 4.25	AF 5.0	CF 5.0	AF 6.0
	Primer	no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer	
	Failure	AF 7.5	AF 10.0	CF 5.0	AF 6.0	AF 6.0	AF 9.0	NF 10.0 CF +	AF 7.5	CF 3.25	AF 4.0	AF 7.5	AF 5.0	AF 7.0	AF 6.0	CF 9.5	AF 7.0	AF 6.75	AF 8.0	CF 6.25	AF 10.0	AF 7.5	CF 7.5	NF >11	AF 8.5	AF 7.25	NF >11 AF/CF+	AF 7.0	AF 10.	NF >11 AF +	NF >11	CF 7.5	CF 8.0	CF 5.0	AF 4.75 CF start
STPes:																																	
STPe Sealants	Primer	no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer	
	Failure	CF 6.25	NF >11.0	CF 7.0	CF 8.5	CF 6.75	CF 8.5	CF 8.0	CF 10.5	CF 2.5	CF 3.0	CF 8.25	CF 8.5	AF 8.5	CF 7.75	CF 3.5	CF 6.0	CF 6.5	CF/AF 8.5	CF 7.25	CF 11.0	AF/CF 5.75	AF/CF 7.0	CF 7.0	CF 10.25	NF >11 CF +	CF 11.0	CF 6.0	CF 8.0	CF 9.0	SF 3.5	CF 4.0	CF 9.5	CF 5.0	CF 5.0 AF 4.75
	Primer	no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer	
	Failure	NF >11	NF >11	CF 8.5	CF 11.0	CF 8.0	CF >11	NF 11.0 CF +	CF 11.0	CF 7.0	CF 7.0	CF 7.0	AF 2.5	CF 11.0	CF 10.0	CF 5.5	CF 6.0	CF 8.75	CF 10.5	CF 9.0	CF >11.0	CF >11	CF >11	CF 10.0	CF 10.5	CF 8.75	AF 10.0 CF+	AF/CF 9.5	CF 10.5	SF 4.0	SF 6.5	AF 6.0 SF 6.25	SF 7.0	CF 10	CF 9.0
Elastomeric Polymers:																																	
Elasto. Polymer Sealants	Primer	no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer	
	Failure	CF 5.25	CF 3.25	CF 2.0	CF 2.0	CF .5	CF 3.0	CF 1.25	CF 2.0	CF 2.5	CF 3.5	CF 3.25	AF 6.0 CF+	CF 1.25	CF 3.0	CF 3.0	CF 2.5	AF 4.5	AF 3.5	AF 4.0	CF 2.5	CF 1.5	CF 1.25	CF 2.0	CF 3.5	CF 3.0	CF 2.0	CF 0.5	CF 3.5	CF 1.75	CF 3.0	CF 2.0	CF 2.5	CF 2.0	AF 2.75 CF start
	Primer	no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer	
	Failure	CF 5.0	CF 3.0	CF 1.0	CF 3.0	CF 1.0	CF 4.25	too soft to pull	CF 0.5	CF 2.5 AF 2.5	AF 3.0	too soft to pull	CF 1.25	CF 2.25	CF 3.0	CF 3.0	CF 1.75	CF 3.0	CF 2.0	CF 2.5	AF/CF 2.0	CF .25	CF 2.5	CF 1.0	CF 2.75	CF 2.0	CF 1.0	too soft to pull	CF 2.0	CF 1.5	CF 6.0	CF 2.0	CF 2.5	AF 2.0 CF2.5	AF/CF 2.25
	Primer	no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer	
	Failure	AF 3.75	AF 4.25	CF 2.5	CF 4.0	CF 2.0	CF 4.5	CF 1.0	CF 1.25	CF 3.0	AF 3.5	CF 2.0	AF/CF 6.0+	CF 3.25	CF 5.25	AF 3.75	CF 5.0	CF 4.5	CF 6.0	CF 5.0	SF/AF 6.5	CF 1.5	CF 6.5	CF 1.75	CF 7.25	CF 1.5	CF 4.25	CF 1.0	CF/AF 4.0	CF 2.0	CF 1.0	AF 3.0	CF 6.0	CF 3.5 AF 3.5	CF 4.75
Polyurethanes:																																	
Polyurethane Sealants	Primer	no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer	
	Failure	AF 6.0	AF 4.25	AF 3.0	AF 4.0	AF 4.0	AF 6.5	AF 3.0	AF 3.0	AF 2.0	AF 2.5	AF 5.0	AF 8.0	CF >11	CF 9.5	AF 3.75 CF 3.75	CF >11	NF >11 less at ink	NF >11 AF at ink	NF 11 SF +	SF 10.0	NF >11	AF 6.5	NF >11	NF >11	AF 9.0 varies w/ ink	AF 9.5	NF >11 AF+	NF >11 AF+	SF 5.25	SF 7.0	AF/CF SUB 8.0	NF 11 SF start	SF 6.5 CF 6.5	CF 8.0 SF at tab
	Primer	no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer	
	Failure	AF 4.0	AF 4.25	AF 1.5	AF 4.0	AF 3.25	AF 2.0	AF 2.25	AF 2.75	AF 3.0	AF 2.5	NF >11 SF/CF +	NF >11	CF >11	NF 11 CF+	CF 6.25	SF/AF 10.0	NF >11	NF >11 AF at ink	SF 10	SF 10.5	NF >11	NF >11	NF >11	NF >11	NF >11	NF >11 AF +	NF >11	NF >11	SF 6.5	NF >11	SF >11	NF 11	CF 11.25	SF 9.5
	Primer	no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer	
	Failure	AF 11	NF >11 AF/CF+	AF 8.0	NF 11.0 CF +	AF 11.0	NF >11	AF 3.25	AF 7.25	AF 10.5	AF 7.5	AF 11.0	NF >11 CF+	AF 5.5	NF 11 CF +	AF 5.25	CF >11	NF >11	AF 10.75 at ink	NF 11 SF +	SF 10.0	NF >11	NF >11	NF >11 CF+	NF >11	AF 4.5	AF 7.0 varies w ink	AF 10.5	AF >11	SF 3.75	SF >11	CF >11	CF 10.5	CF 10	SF 9.0 AF 11.0
	Primer	no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer		no primer	
	Failure	NF >11	NF >11	CF 11.0	AF 10.5	AF 11.0 CF 11.0	NF >11 CF+	NF 11.0 CF+	NF >11	AF 9.0	CF 5.0 AF 5.0	AF 6.0	AF 5.25	CF 7.25	CF 7.5	AF 4.5	SF 10.25	NF >11	AF 10.75 at ink	SF 8.5	SF 9.0	AF 10.25 1/2 beAF	NF >11	AF >11	AF 11	AF 9.75	NF >11	NF >11 AF/CF +	NF >11 AF+	SF 7.25	SF 6.0	AF 9.0	SF 9.0	CF 11.0	CF 8.5

Results: Pull Strengths - SAMs

- **Polyurethanes** tended to have **worse adhesion** to the majority of **foil faced SAMs** as compared to the same manufacturer's polyethylene faced SAMs.
  - Foil faced SAMs are shown with an arrow.
  - SAM Manufacturers are grouped between the green lines

Polyurethanes:

Polyurethane Sealants

Primer	no primer		no primer	
Failure	AF 6.0	AF 4.25	AF 5.0	AF 8.0
Primer	no primer		no primer	
Failure	AF 4.0	AF 4.25	NF >11 SF/CF +	NF >11
Primer	no primer		no primer	
Failure	AF 11	NF >11 AF/CF+	AF 11.0	NF >11 CF+
Primer	no primer		no primer	
Failure	NF >11	NF >11	AF 6.0	AF 5.25

Primer	no primer		no primer		no primer	
Failure	CF >11	CF 9.5	AF 3.75 CF 3.75	CF >11	AF 3.0	AF 4.0
Primer	no primer		no primer		no primer	
Failure	CF >11	NF 11 CF+	CF 6.25	SF/AF 10.0	AF 1.5	AF 4.0
Primer	no primer		no primer		no primer	
Failure	AF 5.5	NF 11 CF +	AF 5.25	CF >11	AF 8.0	NF 11.0 CF +
Primer	no primer		no primer		no primer	
Failure	CF 7.25	CF 7.5	AF 4.5	SF 10.25	CF 11.0	AF 10.5

Primer	no primer		no primer	
Failure	NF >11 less at ink	NF >11 AF at ink	NF 11 SF +	SF 10.0
Primer	no primer		no primer	
Failure	NF >11	NF >11 AF at ink	SF 10	SF 10.5
Primer	no primer		no primer	
Failure	NF >11	AF 10.75 at ink	NF 11 SF +	SF 10.0
Primer	no primer		no primer	
Failure	NF >11	AF 10.75 at ink	SF 8.5	SF 9.0

Primer	no primer		no primer		no primer	
Failure	NF >11	AF 6.5	NF >11	NF >11	AF 4.0	AF 6.5
Primer	no primer		no primer		no primer	
Failure	NF >11	NF >11	NF >11	NF >11	AF 3.25	AF 2.0
Primer	no primer		no primer		no primer	
Failure	NF >11	NF >11	NF >11 CF+	NF >11	AF 11.0	NF >11
Primer	no primer		no primer		no primer	
Failure	AF 10.25 1/2 beAF	NF >11	AF >11	AF 11	AF 11.0 CF 11.0	NF >11 CF+

Primer	no primer		no primer		no primer	
Failure	AF 9.0 varies w/ ink	AF 9.5	NF >11 AF+	NF >11 AF+	AF 3.0	AF 3.0
Primer	no primer		no primer		no primer	
Failure	NF >11 AF +	NF >11	NF >11	NF >11	AF 2.25	AF 2.75
Primer	no primer		no primer		no primer	
Failure	AF 4.5	AF 7.0 varies w ink	AF 10.5	AF >11	AF 3.25	AF 7.25
Primer	no primer		no primer		no primer	
Failure	AF 9.75	NF >11	NF >11 AF/CF +	NF >11 AF+	NF 11.0 CF+	NF >11

Primer	no primer		no primer	
Failure	SF 5.25	SF 7.0	AF/CF SUB 8.0	NF 11 SF start
Primer	no primer		no primer	
Failure	SF 6.5	NF >11	SF >11	NF 11
Primer	no primer		no primer	
Failure	SF 3.75	SF >11	CF >11	CF 10.5
Primer	no primer		no primer	
Failure	SF 7.25	SF 6.0	AF 9.0	SF 9.0

Primer	no primer		no primer	
Failure	SF 6.5 CF 6.5	CF 8.0 SF at tab	AF 2.0	AF 2.5
Primer	no primer		no primer	
Failure	CF 11.25	SF 9.5	AF 3.0	AF 2.5
Primer	no primer		no primer	
Failure	CF 10	SF 9.0 AF 11.0	AF 10.5	AF 7.5
Primer	no primer		no primer	
Failure	CF 11.0	CF 8.5	AF 9.0	CF 5.0 AF 5.0

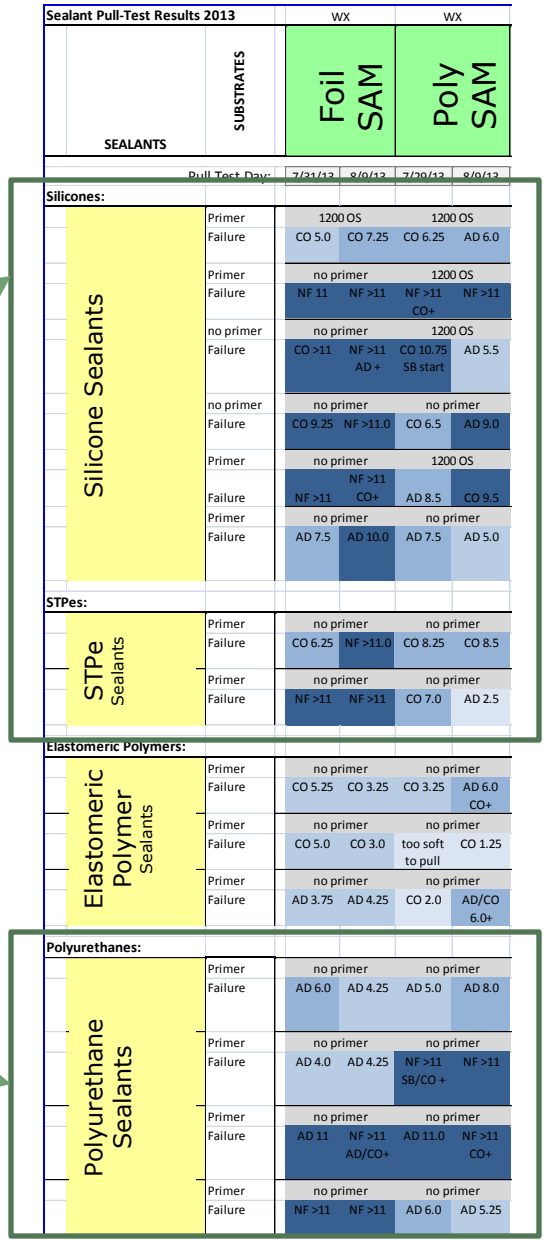
- Don't forget compatibility … more to come

Results: Pull Strengths - SAMs

Specific Product Trends:

- **Silicone and STPe** sealants showed **higher** pull test strengths when adhered to a manufacturer's **foil faced SAM** than to the same manufacturer's polyethylene faced SAM.

- **Polyurethane** sealants showed **higher** pull tests strengths when adhered to a manufacturer's **polyethylene faced SAM** than to the same manufacturer's foil faced SAM.



Sealant Pull-Test Results 2013		WX	WX
SEALANTS	SUBSTRATES	Foil SAM	Poly SAM
Pull Test Day:		7/31/13 8/9/13	7/29/13 8/9/13
Silicones:			
Silicone Sealants	Primer	1200 OS	1200 OS
	Failure	CO 5.0 / CO 7.25	CO 6.25 / AD 6.0
	Primer	no primer	1200 OS
	Failure	NF 11 / NF >11	NF >11 CO+ / NF >11
	no primer	no primer	1200 OS
	Failure	CO >11 / NF >11 AD +	CO 10.75 SB start / AD 5.5
	no primer	no primer	no primer
	Failure	CO 9.25 / NF >11.0	CO 6.5 / AD 9.0
	Primer	no primer	1200 OS
	Failure	NF >11 / NF >11 CO+	AD 8.5 / CO 9.5
	Primer	no primer	no primer
	Failure	AD 7.5 / AD 10.0	AD 7.5 / AD 5.0
STPes:			
STPe Sealants	Primer	no primer	no primer
	Failure	CO 6.25 / NF >11.0	CO 8.25 / CO 8.5
	Primer	no primer	no primer
	Failure	NF >11 / NF >11	CO 7.0 / AD 2.5
Elastomeric Polymers:			
Elastomeric Polymer Sealants	Primer	no primer	no primer
	Failure	CO 5.25 / CO 3.25	CO 3.25 / AD 6.0 CO+
	Primer	no primer	no primer
	Failure	CO 5.0 / CO 3.0	too soft to pull / CO 1.25
	Primer	no primer	no primer
	Failure	AD 3.75 / AD 4.25	CO 2.0 / AD/CO 6.0+
Polyurethanes:			
Polyurethane Sealants	Primer	no primer	no primer
	Failure	AD 6.0 / AD 4.25	AD 5.0 / AD 8.0
	Primer	no primer	no primer
	Failure	AD 4.0 / AD 4.25	NF >11 SB/CO + / NF >11
	Primer	no primer	no primer
	Failure	AD 11 / NF >11 AD/CO+	AD 11.0 / NF >11 CO+
	Primer	no primer	no primer
	Failure	NF >11 / NF >11	AD 6.0 / AD 5.25

Results: Pull Strengths - WRBs

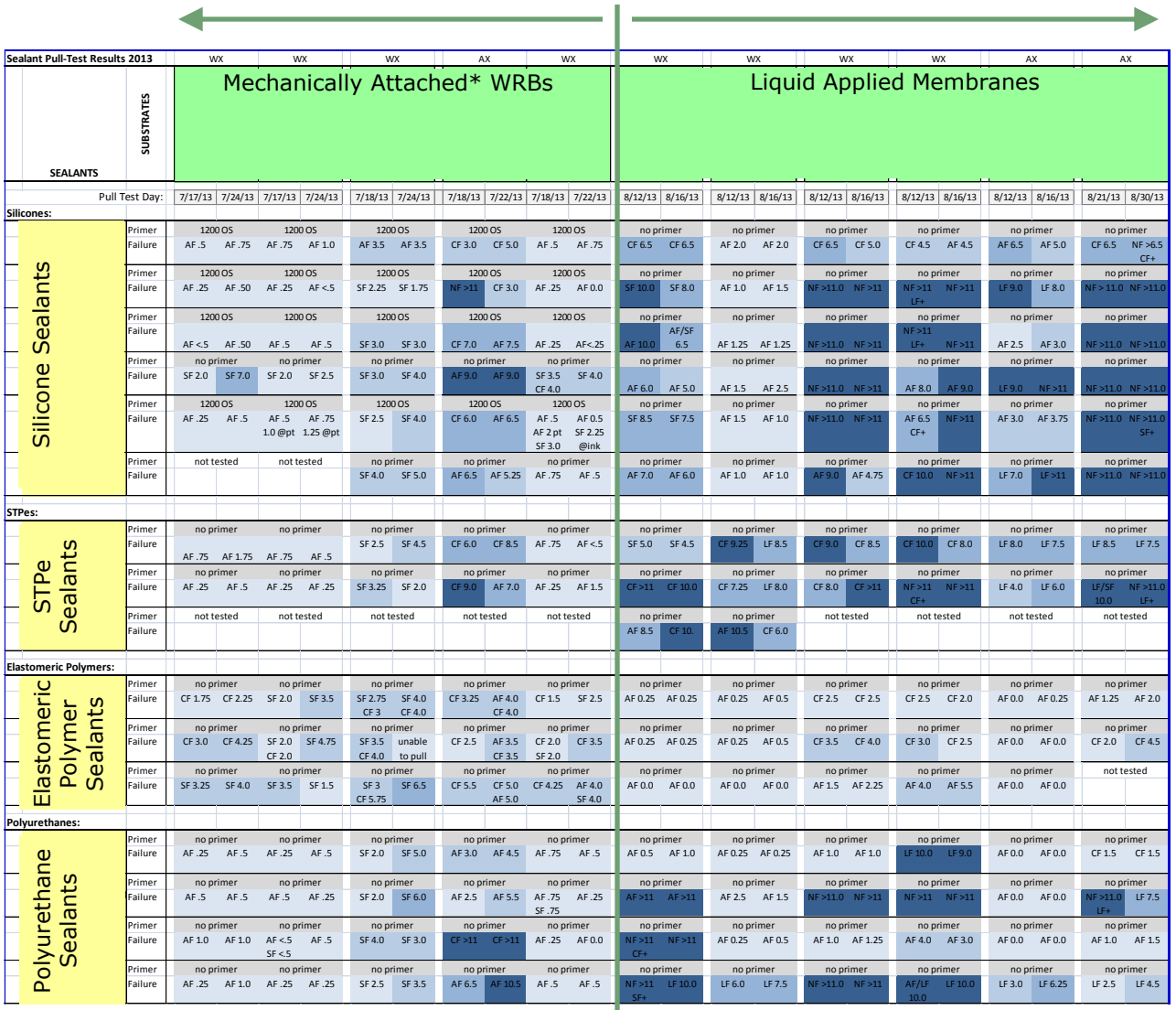
- Mechanically Attached versus Liquid Applied Membranes

- Silicone, STPe and some Polyurethane sealants achieved higher pull strengths when adhered to the Liquid Applied Membranes than to the Mechanically Attached WRBs.

  **includes one product with a asphalt backing and one with a synthetic adhesive.*

- The Elastomeric Polymers did not adhere well to either, but generally did slightly better when applied on sheet WRBs as compared to the Liquid Applied Membranes.

- Consider manufacturer's and design's performance expectations / requirements.



Results: Pull Strengths - WRBs

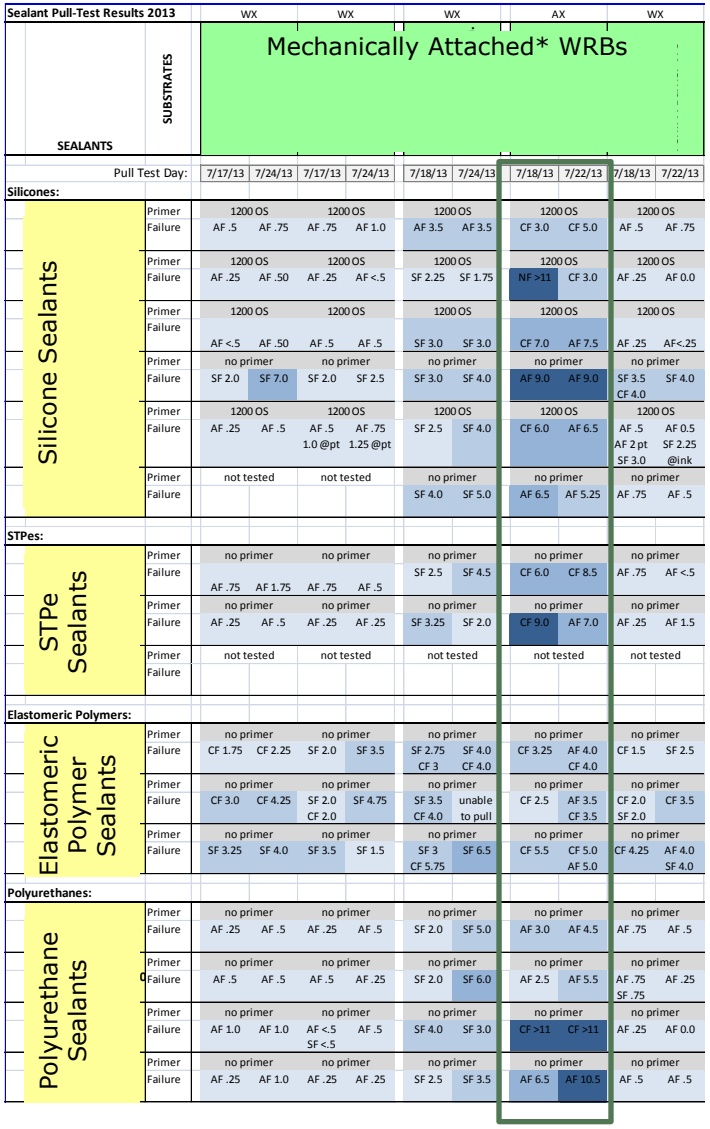
- Polyethylene WRBs versus Polyethylene SAMs

- The majority of the sheet WRBs had very low pull strength numbers with the exception of one that although listed as a wall barrier is also a SAM (smooth polyethylene face with asphalt backing)

- The non butyl or asphalt backed membranes had much lower pull strengths than the typical SAMs

- The majority of WRBs and SAMs are polyethylene or polyethylene faced

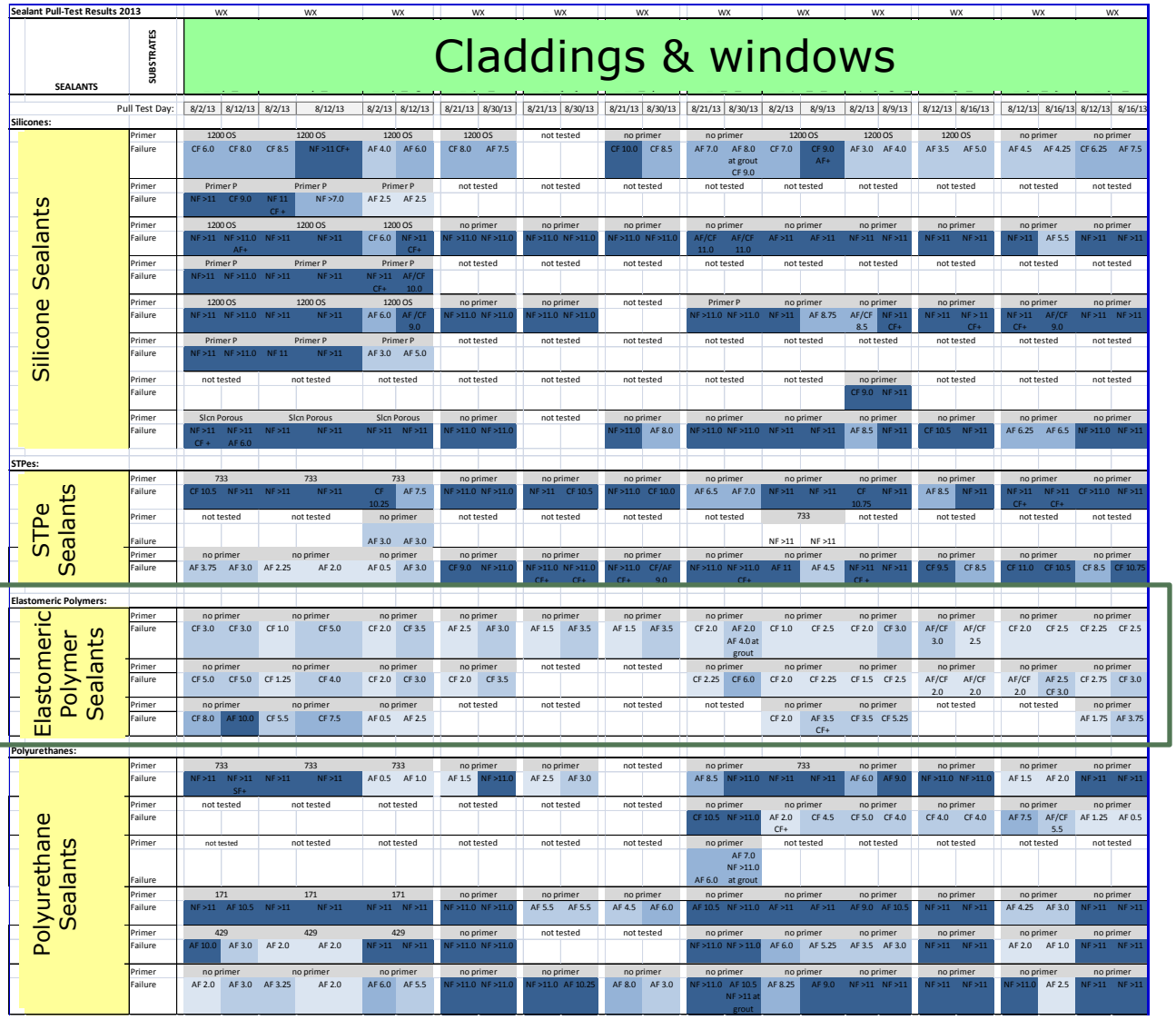
- The manufacturing process and applied coatings vary with every product, however SAMs typically have a smoother, more "plastic", facing



Sealant Pull-Test Results 2013			WX		WX		WX		AX		WX	
SEALANTS		SUBSTRATES	Mechanically Attached* WRBs									
Pull Test Day:			7/17/13	7/24/13	7/17/13	7/24/13	7/18/13	7/24/13	7/18/13	7/22/13	7/18/13	7/22/13
Silicones:												
Silicone Sealants	Primer		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS	
	Failure		AF .5	AF .75	AF .75	AF 1.0	AF 3.5	AF 3.5	CF 3.0	CF 5.0	AF .5	AF .75
	Primer		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS	
	Failure		AF .25	AF .50	AF .25	AF <.5	SF 2.25	SF 1.75	NF >11	CF 3.0	AF .25	AF 0.0
	Primer		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS	
	Failure		AF <.5	AF .50	AF .5	AF .5	SF 3.0	SF 3.0	CF 7.0	AF 7.5	AF .25	AF<.25
	Primer		no primer		no primer		no primer		no primer		no primer	
	Failure		SF 2.0	SF 7.0	SF 2.0	SF 2.5	SF 3.0	SF 4.0	AF 9.0	AF 9.0	SF 3.5 CF 4.0	SF 4.0
	Primer		1200 OS		1200 OS		1200 OS		1200 OS		1200 OS	
	Failure		AF .25	AF .5	AF .5 1.0 @pt	AF .75 1.25 @pt	SF 2.5	SF 4.0	CF 6.0	AF 6.5	AF .5 AF 2 pt SF 3.0	AF 0.5 SF 2.25 @ink
	Primer		not tested		not tested		no primer		no primer		no primer	
	Failure						SF 4.0	SF 5.0	AF 6.5	AF 5.25	AF .75	AF .5
STPes:												
STPe Sealants	Primer		no primer		no primer		no primer		no primer		no primer	
	Failure		AF .75	AF 1.75	AF .75	AF .5	SF 2.5	SF 4.5	CF 6.0	CF 8.5	AF .75	AF <.5
	Primer		no primer		no primer		no primer		no primer		no primer	
	Failure		AF .25	AF .5	AF .25	AF .25	SF 3.25	SF 2.0	CF 9.0	AF 7.0	AF .25	AF 1.5
	Primer		not tested		not tested		not tested		not tested		not tested	
	Failure											
Elastomeric Polymers:												
Elastomeric Polymer Sealants	Primer		no primer		no primer		no primer		no primer		no primer	
	Failure		CF 1.75	CF 2.25	SF 2.0	SF 3.5	SF 2.75 CF 3	SF 4.0 CF 4.0	CF 3.25	AF 4.0 CF 4.0	CF 1.5	SF 2.5
	Primer		no primer		no primer		no primer		no primer		no primer	
	Failure		CF 3.0	CF 4.25	SF 2.0 CF 2.0	SF 4.75	SF 3.5 CF 4.0	unable to pull	CF 2.5	AF 3.5 CF 3.5	CF 2.0 SF 2.0	CF 3.5
	Primer		no primer		no primer		no primer		no primer		no primer	
	Failure		SF 3.25	SF 4.0	SF 3.5	SF 1.5	SF 3 CF 5.75	SF 6.5	CF 5.5	CF 5.0 AF 5.0	CF 4.25	AF 4.0 SF 4.0
Polyurethanes:												
Polyurethane Sealants	Primer		no primer		no primer		no primer		no primer		no primer	
	Failure		AF .25	AF .5	AF .25	AF .5	SF 2.0	SF 5.0	AF 3.0	AF 4.5	AF .75	AF .5
	Primer		no primer		no primer		no primer		no primer		no primer	
	Failure		AF .5	AF .5	AF .5	AF .25	SF 2.0	SF 6.0	AF 2.5	AF 5.5	AF .75 SF .75	AF .25
	Primer		no primer		no primer		no primer		no primer		no primer	
	Failure		AF 1.0	AF 1.0	AF <.5 SF <.5	AF .5	SF 4.0	SF 3.0	CF >11	CF >11	AF .25	AF 0.0
	Primer		no primer		no primer		no primer		no primer		no primer	
	Failure		AF .25	AF 1.0	AF .25	AF .25	SF 2.5	SF 3.5	AF 6.5	AF 10.5	AF .5	AF .5

Results: Pull Strengths - Claddings

- Elastomeric Polymers achieved the lowest pull strengths with Claddings in general.



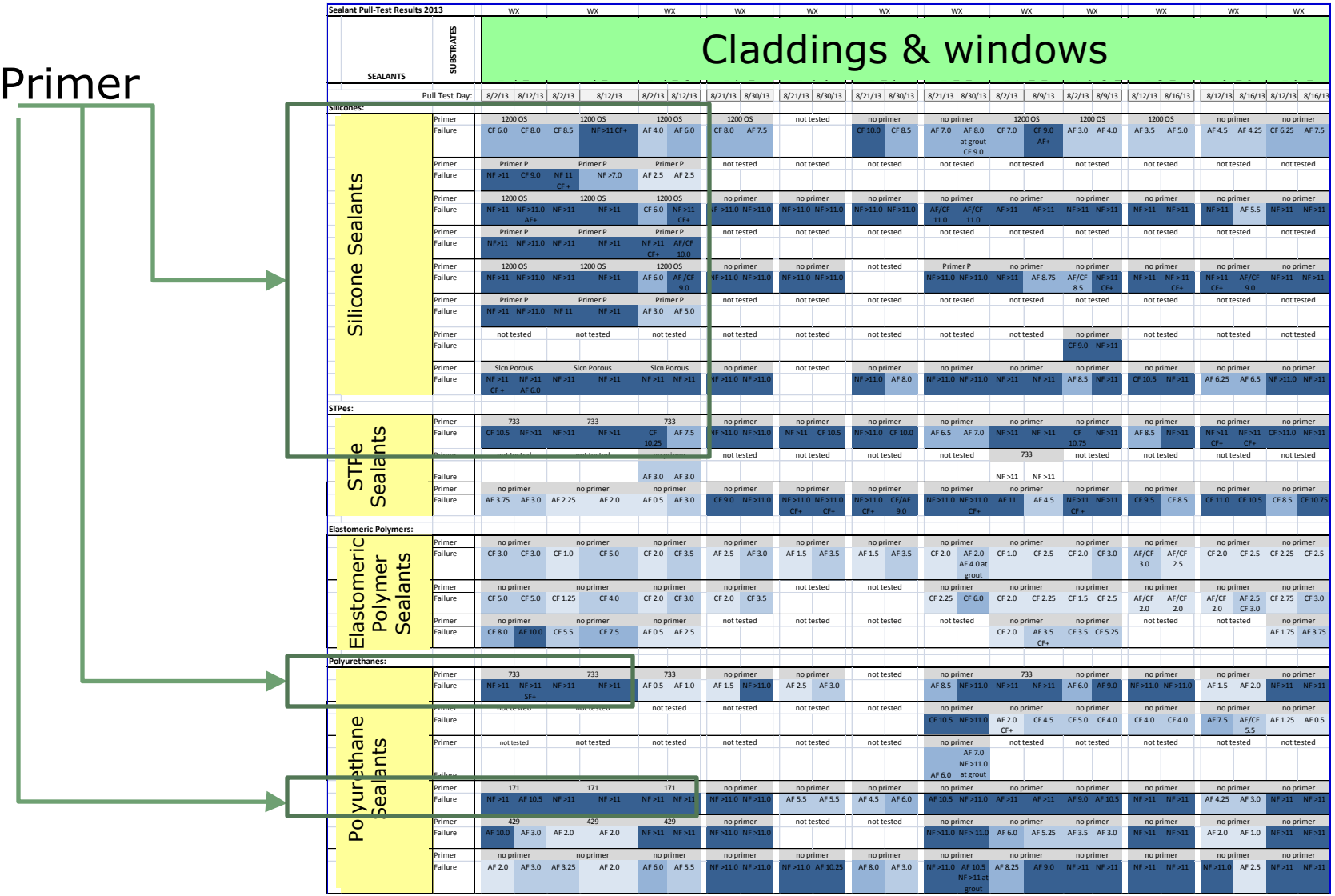
Results: Pull Strengths - Claddings

- Specific Product Trends:
- Polyurethane sealants showed a remarkable increase in pull strengths on the painted vinyl versus white vinyl.
- White vinyl does not have a coating as with other integral colors.
- What is the chemistry of the paint?
- Coatings matter!

		Vinyl Window White		Vinyl Window Coated - Color	
		8/12/13	8/16/13	8/12/13	8/16/13
Polyurethanes:					
Polyurethane Sealants	Primer	no primer		no primer	
	Failure	AF 1.5	AF 2.0	NF >11	NF >11
	Primer	no primer		no primer	
	Failure	AF 7.5	AF/CF 5.5	AF 1.25	AF 0.5
	Primer	not tested		not tested	
	Failure				
	Primer	no primer		no primer	
	Failure	AF 4.25	AF 3.0	NF >11	NF >11
	Primer	no primer		no primer	
	Failure	AF 2.0	AF 1.0	NF >11	NF >11

Results: Pull Strengths - Claddings

- All sealants that were tested with primer, with the exception of one, had high pull strengths.
- Primer



Primers

- Tests with Primers had High Pull Strengths
  - Exception - Adhesive fail of primer to fiber cement siding
  - 7 day @ 10 lbs., 14 day @ 2.0 lbs.

Compatibility

- Discoloration
  - Polyurethanes, Elastomeric Polymers, and STPe sealants showed discoloration when in contact with the SAM backing.
  - Reactions were not dramatic in the study however, field interactions can be more severe.

Observations & Practical Knowledge

- The only acrylic urethane tested severely discolored when applied to primed cedar.
- Cedar has tannins that may have leached into the acrylic urethane sealant.
- The only other sealant that was affected was one silicone that had a slight stain at the back of the bead.

Observations & Practical Knowledge

- Slight discoloration and slumping was observed on some polyurethanes when applied to a silicone LAM.
- Silicone and polyurethane materials are generally not good adhesive partners, although testing should always be done to confirm adhesion and compatibility.

Observations & Practical Knowledge

- A change in sheen was observed in a perimeter around the silicone sealants when applied onto the silicone LAM. This occurred with all silicone sealants.

- Chemical migration of this type is common with stone cladding and can cause discoloration.

- Chemical migration does not always affect the adhesion or other performance characteristics of the sealant but should be verified with the manufacturer.

Observations & Practical Knowledge

- A silicone sealant did not cure after being applied to brick sprayed with isopropyl alcohol (IPA).

- Isopropyl alcohol (IPA) is a common carrier for brick water repellants and can be used as a cleaner prior to sealant application.

- Cure inhibition can occur if the IPA is not given time to fully evaporate.

Observations & Practical Knowledge

- Bubbles were observed in two sealants; however they appeared to be anomalies since there was no pattern to the occurrences.
- Although not a sign of a compatibility issue in the study, bubbles are a common indicator of air movement through sealant.

Observations & Practical Knowledge

- 2 of the 3 the elastomeric polymers tested were highly solvenated leading to high odors with continued off-gassing and obvious shrinkage and soaking into the substrates.

Observations & Practical Knowledge

- Surface coatings affect adhesion.
- Adhesion differences were observed across inked portions of membranes with product brand labeling.

Conclusions

- Recommended cure times are dependant on a sealant's exposure to the proper environment for curing. Many sealants require air and moisture to cure. Curing times can affect the construction schedule.
- Adhesion of sealants to substrates can change over time.
- This study did not test single variables, although in-field applications are also not single variable tests of sealants and substrates.
- Similarities in basic chemistry between sealants and substrates aided in adhesion. However, this is not without exception.
- Coatings and primers can have important effects on adhesion.

Conclusions

- Adhesion to mechanically attached, permeable WRBs was significantly less than to permeable LAMs. However, the manufacturers' and project required performance should be considered.

- Elastomeric polymers exhibited reduced adhesion in comparison to the other groups of sealants. They also exhibited compatibility and other observed issues such as reactions with SAM backings, off-gassing, and shrinkage.

- Non-specific product labeling such as "polymer", "elastomeric", and "proprietary" is not helpful in understanding a product and how it will perform.

- Test early and test often: Project specific materials and conditions.

Questions:

Thank You.

Slides, test board photos, and study report can be found at
http://www.walshconstructionco.com
under 'What's Happening'
http://www.walshconstructionco.com/whats_happening.aspx

Sharon Libby, Quality Assurance Manager
slibby@walshconstructionco.com

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