Construction Sealants 101 – Making the Connections

Building Enclosure Council – Austin
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RPM Incorporated

Consumer

Industrial

Transforming the Built Environment into a High-Performance Environment.
Topics Covered

- Overview of various types of construction sealants
- Typical physical properties of the most commonly used constructions sealant
- Cost Comparison
- Joint Types
- Sealant Application Requirements
- Joint Movement
- Calculating Joint Movement
- Sealant Failures
- Primers
- Sealant Adhesion Testing
- Sealant Tooling
- Sealant Staining
- Warranties
- Making The Connections
Definitions

- **Neutral Cure**: Much better adhesive properties for a greater number of materials including PVC-U, most other plastics, glass, aluminum, lead, stone and masonry, and Polycarbonate. It cures with atmospheric moisture.

- **Acetoxy Cure**: Acetoxy silicone sealants release acetic acid (which smells a little like vinegar) as they cure. This is the most commonly used, it is more rigid and the full cure is quick. On the downside it generally has poor adhesion and leaves much to be desired for in how well it 'sticks' to PVC-U, most other plastics, glass, aluminum and polycarbonate.

- **Chemical Cure**: requires an activator.

- **Modulus**: a low modulus will need just a low force to stretch it and will have better elasticity and movement accommodation, a high modulus is more rigid.
Types of Construction Sealants

- Silicones Sealants
- Extruded Silicone Sheet
- Hybrid Polyurethanes Sealants
- Polyurethanes Sealants
- Polyurethane Impregnated Foams
- Acetoxy Silicones Sealants
- Acrylic/Acrylic Latex Sealants
- Polysulfide Sealants
- Bituminous Sealants
- Synthetic Rubber Sealants
- Thermoplastics Sealants
- Butyl Sealants
- Pick-Proof Sealants
Quick Note:

- Silicones **will** adhere to fully cured urethanes; however **will not** adhere to silicones.
Typical Physical Properties: Silicone Sealants

- **Cure type**: neutral, acetoxy, 2-part
- **Modulus**: low, medium, high
- **Movement Capability**: +/-25%, +/-50%, +100/-50%
- **Finish**: smooth sheen or matte finish
- **Uses**: perimeter joints, silicone sheet adhesive, façade joinery seal, metal-to-metal joints, curtain wall, 2-sided structural glazing, high movement joints, non-stain applications, wet glazing, weather beads, cap beads, toe beads, heal beads, 4-sided structural glazing, bedding sealant, hurricane impact, blast, “band-aid” joint, site sealant… etc.
- **Manufacturer Warranty**: 20 years
- **Benefits**: highest resistance to UV, highest temperature ratings, diversity in use of application, field tinting capabilities
- **Priming**: perform preliminary adhesion tests
Typical Physical Properties: Hybrid Polyurethane Sealants

- **Cure Type**: neutral cure
- **Modulus**: low
- **Movement Capability**: +/- 35%, +/- 50%, +100/-50%
- **Finish**: smooth sheen
- **Uses**: perimeter joints, façade joinery seal, metal-to-metal joints, curtain wall, bedding sealant, under various coatings.
- **Manufacturer Warranty**: 10 years
- **Benefits**: high resistance to UV, high temperature ratings, paintable, and UL listed assemblies
- **Priming**: perform preliminary adhesion tests
Typical Physical Properties: Polyurethane Sealants

- **Cure type**: moisture cure and chemical cure (1-part/2-part)
- **Modulus**: medium
- **Movement Capability**: +/- 35%, +/-50%
- **Finish**: matte
- **Uses**: perimeter joints, façade joinery seal, metal-to-metal joints, curtain wall, bedding sealant, under various coatings, and site work conditions.
- **Manufacturer Warranty**: 5 Years
- **Benefits**: resistance to UV, temperature ratings, paintable, UL listed assemblies, and can be utilized behind various types of waterproofing membranes.
- **Priming**: perform preliminary adhesion tests
Quick Note: Enjoy the clean look while it lasts
Cost Comparison

- Backer Rod = $0.07 per ft
- Labor = $1.00 per ft
- Sealant cost of Polyurethane = 25% of installed sealant price
- Sealant cost of Silicone = 38% of installed sealant price
- 13% increase of installed sealant price with silicone.
- Sealant is typically less than 7% of waterproofing cost
- Waterproofing is typically less than 3% of project cost
- $(.13 \times .07 \times .03) = 0.0003$ or 0.03% increase in total budget price of a project
Joint Types

Static/Fixed Joints
Joint Types

Dynamic/Moving Joints

A

B

C
Quick Note:
Sealant Application Requirements

Sealant Width-to-Depth Recommendations

<table>
<thead>
<tr>
<th>Width</th>
<th>1/4”</th>
<th>3/8”</th>
<th>1/2”</th>
<th>5/8”</th>
<th>3/4”</th>
<th>1”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>3/16”</td>
<td>3/16”</td>
<td>1/4”</td>
<td>3/8”</td>
<td>3/8”</td>
<td>1/2”</td>
</tr>
</tbody>
</table>

Bond Breaker Tape
Joint Movement

Amount of joint movement compared to joint width is measured in a percentage.

Joint Design Width = ½”; Joint Movement = 1/8” = 25%
Calculating Joint Movement

Tremco recommends a 4:1 design factor

Total movement = ¼" (1/8" + 1/8")
Recommended joint width = 1" (4 x ¼" = 1")
Sealant Failures

Substrate Failure

Cohesive Failure
Sealant Failure

Adhesive Failure
Quick Note:
Sealant Adhesion Testing

- Laboratory Evaluation Request
  - ASTM C-1193
- Field Adhesion Tests
  - Determines requirements for priming, substrate joint preparation, and compatibility with form release agents and curing compounds.
Dry Tooling vs. Wet Tooling

- **Dry tooling is always recommended**
- **Wet tooling can create adhesion issues as the liquid used to wet tool soaks into the substrate; potentially attacking the bond line of the sealant.**
Where primers are utilized

- Porous and non-porous substrates
- Stainless Steel – oil residue is often present
- Travertine Panels – very porous which allow water to infiltrate and attack the bond line.
- Brick – chalk residue that acts as a bond breaker
- The utilization of a primer depends on the substrate we are adhering to.
Non-Staining Technology

- Polyurethane/organic sealants historically used
  - Chalking of the sealant material
  - Discoloration or fading
  - Wash down of the chalked material onto the buildings exterior
  - Short life expectancy

- 1970’s -1980’s silicones were introduced
  - Superior UV resistance
  - Superior color retention
  - Superior heat/weathering capability
  - Superior movement capability

- Problems with staining or hydrophobic bloom in silicone sealants
Quick Note:

- **Hydrophobic Bloom:**
  - Believed to be a by-product reaction during the sealant cure process
  - Probably a condensate that permeates from the joint into the substrate pores
  - Similar to the reaction of Siloxane waterproofing sealers
Non-Staining Technology

- What has been done to address staining?
  - Use larger molecular weight fluids and plasticizers
  - Larger sized molecules do not fit into stone pores as easily
  - Formulation changes to improve cure rate and to reduce free silicone levels
  - Reduced polarity on the sealant surface
Industry Assessment For Sealant Stain Potential

- Test methods for porous substrates:
  - ASTM D 2203 (old test)
  - ASTM C 510 (screen test)
  - ASTM C 1248
    - Current industry standard
    - Partially mimics field conditions
Standard Industry Test Stain Potential of Porous Substrates - ASTM C1248

- Test time frame is approximately 2 months
- Evaluates the effects of heat, UV, and compression on the sealant and substrate
- Compared against standard conditions
- Effects observed include substrate discoloration and the change in substrate surface appearance
- Measurement is taken of stain width and depth
- Samples tested are 1” x 1” x 3” (total of 12)
Warranties

- High Performance Silicone Sealants
  - 20 Years Material
- High Performance Hybrid Polyurethane Sealants
  - 10 Years Material
- High Performance Polyurethane Sealants
  - 5 Years Material

DON’T FORGET TO SPECIFY YOUR WARRANTIES!!
Making The Connections
Example #1: Slider Door Connection
Extruded Silicone Sheet
Extruded Silicone Sheet
Extruded Silicone Sheet
Engineered Transition Assembly

Transforming the Built Environment into a High-Performance Environment.
Engineered Transition Assembly
Engineered Transition Assembly
Engineered Transition Assembly
Polyurethane Impregnated Foams
Polyurethane Impregnated Foams
Thank you for your time today.

Ben Rogers – Tremco Sealants and Waterproofing

Cell # - 469-667-0837
Email – brogerstremco@gmail.com