SEALANTS FOR CONSTRUCTION

AIA PROGRAM NUMBER: SIK401
ERIC MUENCH / MARCH 12, 2015

Sika Corporation is an AIA/CES Registered Provider
AIA/CES PROGRAM:

- This AIA/CES program delivers 1 learning unit of credit.
- Please sign the form and add your AIA member number if you wish to obtain credit for this seminar.
- Sika will forward this information to AIA so that you receive credit for this seminar.
LEARNING OBJECTIVES

- Determine the general purpose and role of sealants and adhesives in construction.
- Define sealant classifications and their properties using ASTM C920 and other trade association industry guidelines to help design proper joint details in working drawings.
- Analyze the various chemistries standard in the industry and their performance expectations for the intended application.
- Apply the proper quality control procedures for sealant installation and removal using manufacturers' data sheets and industry best practice methods.
- Review sealant joint configurations.
- Examine typical sealant joint failure modes.
PURPOSE OF JOINT SEALANTS
A PROPERLY INSTALLED SEALANT MUST:

- Stop Water and Air Intrusion

- Join dissimilar materials: Consider Coefficient of Thermal Expansion
  
  Aluminum = 12.9 x 10^{-6} \text{ in/in/deg F}
  
  Concrete = 6.5 x 10^{-6} \text{ in/in/deg F}
  
  Brick = 3.1 x 10^{-6} \text{ in/in/deg F}
  
  Acrylcs = 40 x 10^{-6} \text{ in/in/deg F}

- Sealant joints accommodate differential thermal movement and other structural movements protecting facades & saving energy
TYPICAL CONSTRUCTION APPLICATIONS

Door Perimeter Sealant
- Sikaflex 1a, 15lm, Textured, 2c NS, AT Connection

Expansion Joints in Brickwork
- Sikaflex 1a, 15lm, Textured, 2c NS

Expansion Joints in Cast-in-place Concrete
- Sikaflex 1a, 15lm, 2c NS

Expansion Joints in Precast and Tilt-up Concrete
- Sikaflex 1a, 15lm, 2c NS

Expansion Joints in Runways
- Sikaflex 2c SL, 15 lm SL

Perimeter Joints
- Sikaflex 1c SL, 2c SL

Expansion Joints in Concrete Highways
- Sikaflex 2c SL, 15 lm SL

Curtain wall Expansion Joints
- Sikaflex 1a, 15lm, Textured

Submerged Joints
- Sikaflex 1a, 2c NS

Expansion Joints in Park Deck
- Sikaflex 1c SL, 2c SL, 2c NS TG

Coping Joints
- Sikaflex 1a, 15lm, Textured, 2c NS

Expansion Joints in Granite
- Sikaflex 15lm, 2c NS

Reglet Joints
- Sikaflex 1a, 15lm, Textured

Paver Joints
- Sikaflex 1c SL, 2c SL

Window Perimeters
- Sikaflex 1a, 15lm, Textured, 2c NS

Control Joints
- Sikaflex 1a, 15lm, Textured, 2c NS
ROOFING MEMBRANE SYSTEMS
07 54 19 Thermoplastic Membrane Roofing
07 55 54 Thermoplastic Protected Membrane Roofing
07 55 56 Fluid Applied Protected Membrane Roofing
07 55 63 Vegetated Roofing
07 56 00 Fluid-Applied Roofing

EXTERIOR WALL & FAÇADE SYSTEMS
07 27 26 Fluid Applied Air Barrier
07 92 13 Elastomeric Joint Sealants
08 40 00 Entrances, Storefronts and Curtain Wall Glazing
09 96 53 Elastomeric Coatings

BALCONIES & CANOPIES
03 93 00 Epoxy Waterproofing
07 16 13 Polymer Modified Cement Waterproofing
07 18 13 Pedestrian Traffic Coatings
07 18 16 Vehicular Traffic Coatings
07 54 19 Thermoplastic Membrane Roofing
07 56 00 Fluid-Applied Roofing
09 96 53 Elastomeric Coatings

PARKING & PLAZA DECK WATERPROOFING
03 93 00 Epoxy Waterproofing
07 16 13 Polymer Modified Cement Waterproofing
07 18 13 Pedestrian Traffic Coatings
07 18 16 Vehicular Traffic Coatings
07 54 19 Thermoplastic Membrane Roofing
07 56 00 Fluid-Applied Roofing
09 96 53 Elastomeric Coatings

BELOW GRADE FOUNDATION WATERPROOFING
03 15 13 Waterstops
07 13 54 Thermoplastic Sheet Waterproofing

MECHANICAL ROOM FLOOR FINISHES
07 16 13 Polymer Modified Cement Waterproofing
09 62 00 Specialty Flooring
09 66 23 Epoxy-Resin Terrazzo Flooring
SEALANT CLASSIFICATIONS AND PROPERTIES
Standard Specification for Elastomeric Joint Sealants

This standard is issued under the fixed designation C920; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope
   1.1 This specification covers the properties of a cured single- or multicomponent cold-applied elastomeric joint sealant for sealing, caulk ing, or glazing operations on buildings, plazas, and decks for vehicular or pedestrian use, and types of construction other than highway and airfield pavements and bridges.
   1.2 A sealant meeting the requirements of this specification shall be designated by the manufacturer to be one or more of the types, classes, grades, and uses defined in Section 7.
   1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.
   1.4 This standard is similar, but not identical, to ISO 11600.

2. Referenced Documents
   2.1 ASTM Standards:
       C510 Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants
       C639 Test Method for Rheological (Flow) Properties of Elastomeric Sealants
       C661 Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
       C679 Test Method for Tack-Free Time of Elastomeric Sealants
       C717 Terminology of Building Seals and Sealants
       C719 Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)
       C793 Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants
       C794 Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants

3. Terminology
   3.1 Definitions—Refer to Terminology C717 for definitions of the following terms used in this specification: adhesive failure, caulking, chemically curing sealant, cohesive failure, cure, cured, elastomeric, glazing, joint, primer, seal, sealant.

4. Classification of Sealants
   4.1 A sealant qualifying under this specification shall be classified as to type, grade, class, and use as follows:
       4.1.1 Type 5—A single-component sealant.
       4.1.2 Type M—A multicomponent sealant.
       4.1.3 Grade P—A pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint at 4.4°C (40°F).
       4.1.4 Grade NS—A nonsag or guntable sealant that permits application in joints on vertical surfaces without sagging or slumping when applied at temperatures between 4.4 and 50°C (40 and 122°F).
       4.1.5 Class 100/50—A sealant that when tested for adhesion and cohesion under cyclic movement (8.8) shall withstand an increase of at least 100% and a decrease of at least 50% of the joint width as measured at the time of application, and, in addition, meet all the requirements of this specification.
       4.1.7 Class 35—A sealant that when tested for adhesion and cohesion under cyclic movement (8.8) shall withstand an increase and decrease of at least 50% of the joint width as measured at the time of application, and, in addition, meet all the requirements of this specification.
ASTM C 920

- Comprehensive and most important sealant specification
- Passage of ASTM C 920 requires passage of specific ASTM tests
- Description:
  “This specification covers the properties of a cured single- or multicomponent cold-applied elastomeric joint sealant for sealing, caulking, or glazing operations on buildings, plazas, and decks for vehicular or pedestrian use, and types of construction other than highway and airfield pavements and bridges.”
- Useful as a lens to look at important sealant properties – what differentiates products to support specifying decisions.
RESULTS OF ASTM C920 SEALANT SPECIFICATION

- **Type S or M**: Single or Multi-Component
- **Grade P or NS**: Pourable or Non-Sag
- **Class**: Cyclic Joint Movement
  +100/-50, +50/-50, +35/-35, +25/-25, +12.5/-12.5
- **Use**: T, NT, I, M, G, A, O
  Traffic, Non-traffic, Immersion, Mortar, Glass, Aluminium, Other
ADHESION

- ASTM C 794
- Nearly always most important requirement – often drives decisions
- There are general rules of thumb, but specific product + substrate knowledge is better, and field adhesion testing is best
- Primers often allow sealants to adhere to substrates they wouldn’t normally, but incur additional cost and complexity – primerless adhesion preferred
MOVEMENT CAPABILITY

- ASTM C 719
- Ability to accommodate expansion and compression in joint and maintain a functional seal
- Required movement capability generally determined through theoretical joint design and includes a safety factor
- Can range from <10% (low performance latex) to +100/-50% (high performance PU or silicone)
  
  Many general purpose construction sealants range from +/-25% to +/-50%
MOVEMENT CAPABILITY

- Measured by ASTM C 719
MOVEMENT CONSIDERATIONS

WORKING JOINT

EXTENSION

ORIGINAL

COMPRESSION

ORIGINAL

SHEAR
HARDNESS

- ASTM C 661/ASTM D 2240
- Ability to deform when force is applied
- Related to sealant’s modulus
- Higher hardness useful in horizontal traffic/high wear applications
MODULUS

- **Low Modulus Sealant** – Creates low stress at the sealant bond line. Usually has a higher movement capability. Useful for low tensile strength, “delicate” substrates (EIFS)
- **Medium Modulus Sealant** – Typically a general purpose sealant that can be used for the majority of elastomeric sealant applications
- **High Modulus Sealant** – Not used for moving joints, typically used for glazing applications
MODULUS

- Low Modulus: 5 lbs.
- High Modulus: 10 lbs.
WEATHERING

- ASTM C 793
- ASTM C 1246
- Resistance to UV radiation, heat and weather effects – long term durability of seal
- Silicone has intrinsically excellent UV resistance – strong Si-O bonds
- PU very good weathering in non-extreme environments, but silicone more capable in extreme environments
STAIN AND COLOR CHANGE

- ASTM C 510
- ASTM C 1248 (not in C920, more rigorous on “tougher” substrates)
- Plasticizer migration often causes staining with silicones on porous substrates
- Heat, humidity and compression increase the chance of staining
- Specific silicones can and have been formulated to perform well enough in practical situations to be considered “non-staining”
COMPATIBILITY - STAINING
GUNNABILITY

- ASTM C 1183
- Ease with which sealant is applied
- Based on extrusion force

  Varies greatly for PU with temperature and age – hard to gun when cold or old
  Less variable for silicone – no difference at low temperatures and becomes easier to gun with age

- Main factor for an applicator liking specific products
TACK-FREE TIME

- ASTM C 679
- How quickly the top sealant layer cures
- Related to overall cure rate
- Sealants with longer tack free times are more susceptible to dirt pickup
- Sometimes silicone plasticizer can be mistaken for sealant tack on cured joint surfaces
RHEOLOGY

- ASTM C 639
- Sag resistance – ability to stay in vertical joints and not flow down with gravity
- Self leveling – ability to “self-tool” in horizontal joints
DURABILITY IN LIQUID IMMERSION

- ASTM C 1247
- Ability to maintain adhesion and seal while submerged in water (or other liquids)
- Water attacks silicone at bond line causing problems when submerged in water
SUMMARY MOST IMPORTANT SEALANT PROPERTIES

- Flexibility
  - Modulus
  - Movement Capability
- Adhesion
  - Primer requirements
  - Compatibility
- Durability
  - Change of Properties
  - Life Expectancy

Worth the study: while less than 1/10th of 1% the total building cost, background reason for the number 2 most common building owner complaint
# SEALANT DURABILITY / PROPERTY CHANGE

<table>
<thead>
<tr>
<th>Sealant Type</th>
<th>Duration</th>
<th>Property Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylic</td>
<td>1-5 years</td>
<td>Elasticity loss, Color change</td>
</tr>
<tr>
<td>Polysulfide</td>
<td>5-15 years</td>
<td>Elasticity loss, Surface cracking</td>
</tr>
<tr>
<td>Butyl</td>
<td>1-10 years</td>
<td>Elasticity loss</td>
</tr>
<tr>
<td>Hybrids</td>
<td>5-15 years</td>
<td>Elasticity loss</td>
</tr>
<tr>
<td>Polyurethane</td>
<td>5-15 years</td>
<td>Elasticity loss, Color change</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surface cracking, Chalking</td>
</tr>
<tr>
<td>Silicone/Extrusions</td>
<td>10 + years</td>
<td>UV stable, Potential adh loss</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dirt pick up</td>
</tr>
</tbody>
</table>
WHAT DO YOU NEED TO CONSIDER?

- What owners, specifiers and contractors must understand is that many times to get a WANT you have to sacrifice a MUST HAVE. It is this balance that requires knowledge about a specific sealant and not the specific sealant chemistry / technology.
SEALANT CHEMISTRIES
WHY DOES SEALANT CHEMISTRY MATTER?

- General performance characteristics/strengths and weaknesses
- Guide recommendations
- Understand market beliefs about products – people will generalize and not be aware of new technology
WHY DOESN’T SEALANT CHEMISTRY MATTER?

- Individual products vary
- Technology improves
- Always exceptions to guidelines
- Each type has its place in the market
PERFORMANCE CLASSES

- **Low Performance**
  - no specification
  - Less than 5% joint movement
  - 2 – 10 year service life

- **Medium Performance**
  - ASTM C834 (latex), C1311 (solvent release)
  - 5 – 12.5% joint movement
  - 5 – 15 year service life

- **High Performance**
  - ASTM C920 (most used), C1184 (structural silicone)
  - Greater than 12.5% joint movement
    - up to +100/-50% joint movement
  - 10 – 50 year service life
COMMON SEALANT TYPES

- Liquid Applied:
  - Latex
  - Acrylic
  - Butyls
  - Polysulfides
  - Hybrids (STP/SPUR/MS)
  - Polyurethanes
  - Silicones
LATEX

- Some refer to as caulk not sealant
- Interior applications
- +/- 10% movement capability or less
- Paintable with latex paints
- Interior applications only
  - Dry wall to trim work
- Not for “true” joints (those expected to exhibit significant cyclic movement)
- “Painters’ Caulk”
ACRYLIC

- Some refer to as caulk not sealant
- Generally +/- 12.5% movement
- More flexible than latex caulks but still not high performance by industry standards
- Can be paintable
- Meet ASTM C 834
BUTYL

- Bond excellent to most substrates
- Poor movement, generally +/-10% or less
- Poor weathering
- Good as adhesive in industrial and packaging applications
- Sometime used in curtain wall where adhesion to rubber compounds is needed
- Most are stringy and difficult to apply neatly
  - More plastic than elastic
POLYSULFIDE

- The first ‘high performance’ sealant chemistry
- Do not perform as well as newer polyurethanes and silicones in moving joints
- Poor recovery
- Can be formulated for excellent chemical resistance
- Good in submerged applications
- Require primer on almost all substrates
HYBRID

- Variations:
  - Silane Terminated Polyether (STP)
  - Silane Terminated Polyurethane (SPUR)
  - Modified Silicone (MS)
- Can reach +100/-50% joint movement
- Excellent adhesion, especially primerless to non-porous substrates
- Can be formulated for excellent UV resistance and weathering (non-yellowing)
- Good low temperature handling characteristics
POLYURETHANE

- Can reach +100/-50% joint movement
- Excellent primerless adhesion to porous substrates
- Paintable
- More forgiving of less than perfect application
- Can be formulated as moisture curing (1 component) or chemical curing (2 component)
- Good weathering, but UV exposure will discolor white PU joints and cause damage over time
- Bubbling during curing can be problematic
SILICONE

- Curing systems
  - Oxime (neutral)
  - Alkoxy (neutral)
  - Amide (basic)
  - Acetoxy (acidic)
- Can reach +100/-50% joint movement
- Excellent primerless adhesion to non-porous substrates, can be formulated for good porous adhesion
- Excellent UV resistance and weathering
- Best (only) choice for structural glazing
- Not paintable
- Staining and streaking can be an issue
SILICONE NEUTRAL CURE

- Inorganic Sealant
- U.V. Stable & weather resistant
- Long life expectance (10 to 20 years or more)
- +/-25 to +100/-50% movement
- Moderate adhesion for some substrates
- Remains elastomeric, maintaining same modulus from -60° to 300° F
- Potentially staining - new technology non-staining
- Generally not paintable- 1 low and 1 medium performance version available
- High MVT rate - not for below grade or underwater
SILICONE ACETOXY CURE - HIGH MODULUS

- UV Stable/10-20 yr
- +/- 25% Movement
- Poor adhesion to Vinyl, Concrete, Masonry
- Glass clear excellent for monolithic glass
- Consumer/DIY- sanitary applications
- Staining, Not paintable
- High MVT / No below grade or underwater
- High Temp. resistance version available
NEUTRAL CURE SILICONE
MEDIUM AND HIGH MODULUS

- Structural glazing
- Panel attachment
- Weathersealing
- Non-structural glazing
NEUTRAL CURE SILICONE
LOW MODULUS

- EIFS
- Expansion joints
- Weather seals only
SILICONE EXTRUSIONS

- U.V. stable & weather resistant
- Long life expectance (10 to 20 years or more)
- +200/-75% movement
- Remain elastomeric from -60° to 300° F
- Non-staining / Not paintable
- High MVT rate - not for below grade or underwater
- Higher material cost but less labor cost
- Excellent for renovation, especially PCB containing polysulfide
## SILICONE TECHNICAL BACKGROUND

<table>
<thead>
<tr>
<th></th>
<th>Oxime</th>
<th>Alkoxy</th>
<th>Acetoxy</th>
<th>Amide</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cure type</strong></td>
<td>Neutral</td>
<td>Neutral</td>
<td>Acidic</td>
<td>Alkaline</td>
</tr>
<tr>
<td><strong>Stability</strong></td>
<td>Stable</td>
<td>Less stable</td>
<td>Very stable</td>
<td>Stable</td>
</tr>
<tr>
<td><strong>Corrosion</strong></td>
<td>Discolor copper and brass</td>
<td>Discolor copper</td>
<td>Corrodes concrete &amp; masonry</td>
<td></td>
</tr>
<tr>
<td><strong>Odor</strong></td>
<td>Slightly “musty” smell</td>
<td>Low odor</td>
<td>Vinegar smell</td>
<td>Low odor</td>
</tr>
</tbody>
</table>
| **Other**        | • Can be formulated non-staining  
                  | • Good temperature resistance  
                  | • White yellows indoors (adhesion promoters) |                      |
|                  | • Can be formulated non-staining  
                  | • Cures softer than oxime  
                  | • Worse temperature resistance than oxime |                      |
|                  | • Fast curing          
                  | • Best temperature resistance  
                  | • Typically higher modulus  |                      |
|                  | • Great cohesive strength  
                  | • Will inhibit other silicone curing  
                  | • Not as good on non-porous  
                  | • Exclusive to DC          |
## APPLICATION COMPARISON

<table>
<thead>
<tr>
<th>Use</th>
<th>Latex</th>
<th>Acrylic</th>
<th>Butyl</th>
<th>Polysulfid</th>
<th>Hybrid</th>
<th>Silicone</th>
<th>PU</th>
</tr>
</thead>
<tbody>
<tr>
<td>submerged</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>interior</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>exterior</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>struct. glazing</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>window perimeter</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>expansion joints</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>traffic joints</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>wide joints</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>paintable</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>chem. resist</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>EIFS</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Tilt-up</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>pre-cast</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>cast-in-place</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>brickwork</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>curtain wall</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>UV resistance</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

1=NR, 2=poor, 3=good, 4=excellent
SEALANT JOINT DESIGN
PROPER JOINT DESIGN

- NEVER design to movement capability of the sealant- allow for safety factor, erection tolerance, time of year, etc.
- 2 x’s expected movement for low to medium modulus sealants, 4x’s + for medium to high modulus sealants
- ¼”x¼” smallest working joint size
- 3/8” to 1”, 2 to 1 width to depth ratio up to 1”, then never deeper than 3/8” to ½ max.”
MOST COMMON JOINT DESIGNS

- Hourglass Joint / Butt joint
- Fillet Joint
- Overlay Joint
- Double Weather Seal
HOURGLASS JOINT

- 2 to 1 width to depth ratio
- Avoid 3 sided adhesion
- Minimizes center point thickness (thin rubber band) & maximizes bond line
FILLET JOINT

- At perpendicular surfaces
- 1/4” minimum contact on each substrate
- Use bond breaker tape or triangular backer
- Cut back gasket for wet sealing glazing systems
JOINT BRIDGING OR OVERLAY JOINTS

- Bridges existing sealant joint
- 3/8” min. sealant contact
- 1/8” depth for wet sealants
- Use precured- extruded sealant or gasket
- With EIFS, center cut failed sealant to relieve stress
DOUBLE WEATHERSEAL JOINT

- Rain screen principal
- Requires drainage
- Consider sealant curing process
- Often difficult to install
- Not redundancy- pressure equalization
TYPICAL FAILURE MODES
JOINT SEALANTS
COMMON PROBLEMS

- There is both science and art to completion of proper joints from design to sealant placement
- Need to have:
  - Proper joint design
  - Proper product
  - Proper application
Sealants are probably the least thought about and add the lowest percentage to a project cost......

........however can become the biggest problem if the building starts to leak.
SEALANT JOINT FAILURE
FOUR MODES OF FAILURE

- Adhesive Failure
- Cohesive Failure
- Sealant Deterioration
- Substrate Failure/Coating Delamination
JOINT SEALANTS
COMMON PROBLEMS
JOINT SEALANTS

COMMON PROBLEMS
JOINT SEALANTS
COMMON PROBLEMS

Sealant Aesthetics- Silicone: Staining, Fluid migration, Dirt pick up, Residue run down
JOINT SEALANTS

COMMON PROBLEMS
JOINT SEALANTS
COMMON PROBLEMS
JOINT SEALANTS
COMMON PROBLEMS
JOINT SEALANTS

COMMON PROBLEMS
JOINT SEALANTS
COMMON PROBLEMS
JOINT SEALANTS
COMMON PROBLEMS
JOINT SEALANTS
COMMON PROBLEMS
JOINT SEALANTS

COMMON PROBLEMS
JOINT SEALANTS
COMMON PROBLEMS
ADHESIVE FAILURE ANALYSIS/CAUSE

- Improper Surface Preparation
- Improper or No Primer
- Sealant/substrate System not tested
- Joint not designed for the actual movement

Measure the movement for a day(s)
Estimate it for the year

+/- 25% sealant  => movement x 4
+/- 50% sealant  => movement x 2
INSTALLATION AND QUALITY CONTROL
ADHESION TESTING

ASTM C-794 adhesion in peel

Metal

Anodized Aluminum
Painted Aluminum
Alodine Aluminum
NO MILL FINISH (in structural glazing)

Glass

Annealed, Tempered or Heat Strengthened
Insulating Glass
Spandrel Glass

Stone, Concrete,
Masonry
Form Release
Agents?
Penetrating Sealers?
BACKER ROD
CLOSED CELL VS OPEN CELL
PROPERLY INSTALLING BACKER ROD
EFFECT OF SHAPE ON MAXIMUM STRAIN “S”
GET THE TOOLING RIGHT!

**BUTT JOINTS**

1. **JOINT DEPTH TO WIDTH RATIO 2:1**
   - **(A) AS INSTALLED MEAN WIDTH**
     - Units of Sealant Required: 4
     - \( d = 2w \)
     - \( S = 0 \)
   - **(B) JOINT OPEN**
     - \( S = 94\% \)
   - **(C) JOINT CLOSED**
     - \( S = 250\% \)

2. **JOINT DEPTH TO WIDTH RATIO 1:1**
   - **(A) AS INSTALLED MEAN WIDTH**
     - Units of Sealant Required: 2
     - \( d = w \)
     - \( S = 0 \)
   - **(B) JOINT OPEN**
     - \( S = 62\% \)
   - **(C) JOINT CLOSED**
     - \( S = 60\% \)

3. **JOINT DEPTH TO WIDTH RATIO 1:2**
   - **(A) AS INSTALLED MEAN WIDTH**
     - Units of Sealant Required: 1
     - \( d = \frac{1}{2}w \)
     - \( S = 0 \)
   - **(B) JOINT OPEN**
     - \( S = 32\% \)
   - **(C) JOINT CLOSED**
     - \( S = 20\% \)
If resealing checking for compatibility

Silicones bond to silicones and urethanes

Urethanes bond to urethanes

- Priming
- Install Backer Material (Closed or Open Cell / Tape) to a uniform depth
- Install Sealant
- Cleaning (mechanical for resealing and then double rag wipe)
- Completely fill joint
- Push bead instead of pulling bead
- Push sealant into joint to wet sides of joint (Don’t just scoop out excess)
SEALANT INSTALLATION
CLEAN, PRIME, PACK, SHOOT, TOOL

- Tool Sealant with rounded spatula in one direction before sealant loses working time
- Dry tool only - avoid tooling aids like soap and solvents
- Quality Control
  - Follow manufacturer’s guidelines
  - Perform Field Adhesions Tests
  - Document results of field adhesion tests
JOINT RESEALING

- Remove all existing failed sealant
- Use a caulk cutter & grinder to completely remove
- Consider bridge joints with EIFS and small joints in metal curtainwall
- **Always** perform pre-job field adhesion tests to verify adhesion
- Gather owner records- previous treatment of substrates?
INSTALLATION TEMPERATURE

1. SEALANT INSTALLED AT MEAN TEMPERATURE
   (A) INSTALLATION AT MEAN TEMPERATURES 55 F (13 C)
   (B) JOINT OPEN AT -20 F (-29 C)
   (C) JOINT CLOSED AT 130 F (54 C)

Sealant must extend or compress by 50 percent in service.

2. SEALANT INSTALLED AT LOW TEMPERATURE
   (A) INSTALLATION AT MINIMUM TEMPERATURES -20 F (-29 C)
   (B) JOINT HALF CLOSED AT 55 F (13 C)
   (C) JOINT CLOSED AT 130 F (54 C)

Sealant must compress by 66.66 percent in service.
Probability of Permanent Deformation or Extrusion. 50 percent more sealant needed.

3. SEALANT INSTALLED AT HIGH TEMPERATURE
   (A) INSTALLATION AT MAXIMUM TEMPERATURE 130 F (54 C)
   (B) JOINT HALF OPEN AT 55 F (13 C)
   (C) JOINT OPEN AT -20 F (-29 C)

Sealant must extend by 200 percent in service.
Adhesion, cohesion, or peeling failure certain.
SOURCES OF SEALANT INFORMATION

SWRI - Sealants: The Professionals Guide
Various ASTM Technical Publications
ASTM C-794 Adhesion in Peel
ASTM C-1382 EIFS/Sealant Test Method
ASTM C-920 Standard Sealant Specification
ASTM C-1193 Guide for Use of Sealants
EIMA Guide and Test Method for Sealants, AAMA
Manuals, ACI, GANA, NGA
Manufacturer’s Sealant or Adhesive Application guides, Data Sheets and/or project specific recommendations
Curtainwall, roofing & other sealant consultant specifications
CONCLUSION OF AIA PRESENTATION.

QUESTIONS??
QUESTION?

- What is.....?