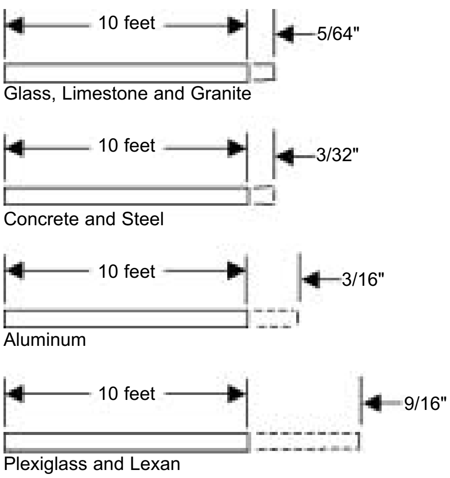
# Why Sealants Fail

## Substrate Movement and Joint Design

To achieve proper joint design, two factors must be considered: the movement of the substrates, and the movement capabilities of the sealant. The information below is provided to help you determine these movements and select an adequate joint width for your application.

Substrate expansion of a 10 foot length over a 100°F temperature range:




Movement to joint width guideline:
- 10% Movement Materials – Butyl Rubbers and Acrylic Latex sealants. Movement x 10 = Joint Width
- 25% Movement Materials – Polyurethanes and Silicones. Movement x 4 = Joint Width
- 50% Movement Materials _ Polyurethanes and Silicones. Movement x 2 = Joint Width

In addition, the following should also be taken into consideration:
- A minimum of 1/4" sealant substrate bond is necessary to ensure adequate adhesion.
- One-part sealants require atmospheric moisture to fully cure. The sealant joint must be designed to ensure that the sealant is not isolated from the air.
- A minimum 1/4" joint width is recommended. Wider joints accommodate more movement than narrow joints. As the sealant joint width becomes larger than 1", the depth should be held to approximately 3/8".
- Three-sided adhesion limits the amount of movement that a joint can accept before failing. Three-sided adhesion can be eliminated by the addition of a bond breaker tape or backer rod.
- A thin bead of sealant (1/4" ± 1/8" depth) will accommodate more movement than a thick bead.
- Optimum performance is also delivered when the sealant bead is shaped like an hourglass formed from round backer rod at the bottom and tooling the top with a rounded spatula tool.

Based on the above information, sometimes you will encounter a bad joint design in which no sealant will function properly. In these instances, contact the architect or general contractor to advise them of the poor joint design so they can take positive actions to resolve the design problems.

## Substrate Movement During Cure

One-part sealants cure by reacting with atmospheric moisture. Joint movement during cure can cause unsightly aesthetics due to joint wrinkling, and in some severe cases, cohesive failure of the sealant. Premature adhesion loss can also occur because the adhesive characteristics of the sealant are obtained after the sealant has cured. Adhesion loss due to movement during cure can be minimized by the use of a primer. Primers can decrease the adhesion cure time lag.

Minimize wrinkling by following these suggestions.
- Use open-cell polyurethane backer rod in vertical applications to allow air to the sealant from the backside to speed up curing time.
- Apply sealant when the joint surface is cool and will experience minimum temperature changes, typically in the late afternoon or early evening.

## Improper Surface Preparation

All surfaces must be clean, dry, dust free and frost free prior to sealant application. This means removal of all dirt, dust, oils and all other forms of surface contaminants prior to the application of any sealant materials.

Remove all surface contaminants:
- Sacking and dust from concrete
- Concrete form-release agents, water repellents, surface treatments, protective coatings
- Old sealants
- Oil from metals
- Surface protectors from metal or glass
- Dust from all surfaces

Improper cleaning solvents:
- Oil based solvents that leave a residue
- Soaps or detergents that leave a film
- Contaminated rags or wipes

Proper cleaning solvents:
- 50% solution of isopropyl alcohol (IPA) and water, 70% solution of IPA and water (rubbing alcohol) or pure IPA for non-oily dirt and dust.
- Methylethylketone (MEK), Xylene or Toluene for oil and grease.
- IPA and MEK are soluble in water and may be more appropriate for winter cleaning as they help in removing condensation and frost.

Use primer when required:
- Certain substrates that chalk or oxidize require primer (see manufacturer's spec sheet)
- Joints subject to water submersion

Surface condition at time of application: Sealing to wet or frosty surfaces will cause sealant failure.

See the Technical Article "Surface Preparation and Proper Application" under "What's New" on our home page for additional information.

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### Wrong Sealant Selection

Incorrect sealant selection can and will lead to many sealant failures. Consult CRL's Product Manager for Construction Sealants to ensure the proper sealant is selected for your project. Listed below are some of the wrong applications.

Applications that are sure to cause problems:
- Low performance sealants in high movement joints
- Using silicone sealant if surface is to be painted
- Butyl sealants on wide precast panel joints
- Urethane sealants on structural glazing
- Sealants in underwater applications
- Solvent based sealants to certain paints, plastics and foams
- Silicone sealants to marble and natural stone (staining)
- Urethane or acrylic sealants as a glazing cap bead (U.V. breakdown)

### Incompatible Materials

Sealants may react with materials that are deemed to be incompatible with that sealant. If you're not sure of the compatibility of your sealant to a substrate, call CRL's Sealant Specialist for clarification.

Some incompatible applications:
- Acetoxy silicone to copper
- Latex to bare steel
- All silicones to neoprene rubber
- Acetoxy silicone to most insulating glass sealants
- Solvent based sealants to plastic and rubber (test)

### Poor Weather and / or U.V. Resistance

U.V., ozone and weather conditions are major factors in selecting the proper sealant. Jobs in large metropolitan areas are subject to smog and other airborne contaminants; jobs in rural areas are subject to temperature ranges that may exceed the manufacturer's suggested application range. If you need help in this area, feel free to call us, or you may reference the Spec Data sheets for our sealants from the offer page for each sealant.

Applications to be aware of:
- Low performance caulks have poor U.V. resistance
- Never apply caulks above/below the manufacturer's suggested application temperature range
- U.V. and ozone attack butyls, acrylics and urethanes (chalking and crazing)

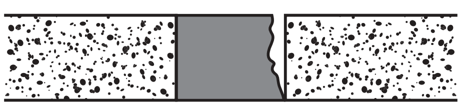
### Using Material Beyond Its Shelf Life

All sealants have a published shelf life. A sealant that has exceeded the published shelf life may cause sealant failure if used without testing.

General guidelines on shelf life:
- Oil based caulks and butyls – 12 months
- Acrylics and construction urethanes – 12 months
- Silicone (acetoxy) – 24 months
- Silicone (neutral cure) – 12 months
- Automotive urethanes – 9 months

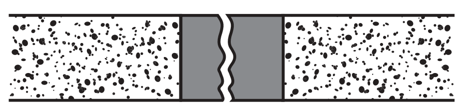
## Three Basic Types of Sealant Failure

### Adhesive



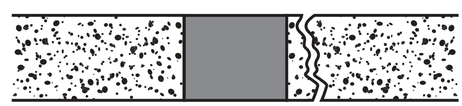
"Loss of Adhesion" is failure of the sealant to adhere along the bond line of the surface to which it is attached, causing it to break away. Possible causes are joint movement exceeding the sealant capability, improper surface preparation, or improper bead configuration.

### Cohesive



"Cohesive Failure" occurs when the sealant fails to hold together . Cohesive failure can take the form of splits and tears in both transverse and longitudinal directions. Usual causes include improper sealant selection, poor mixing of multi-component sealants, possible air entrapment in the sealant from mixing, or improper bead configuration.

### Substrate

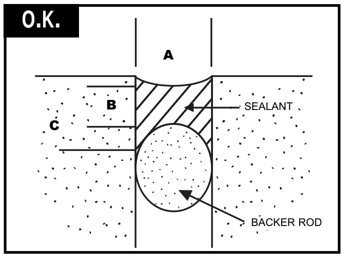


"Substrate Failure" is not a failure of the sealant itself, but of the surface or substrate to which it is supposed to adhere. Substrate failure results from improper surface preparation. The weak interface depicted here should have been saw cut back to prevent loose pieces of the surface material from breaking away from the joint interface.

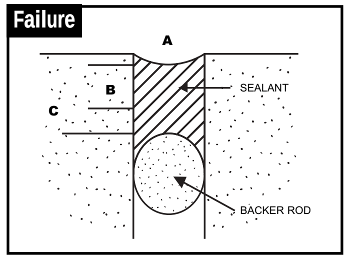
# Other Factors That Cause Sealant Failures: Poor Joint Design or Application

Failures occur when the design of the joint exceeds the ability of the sealant to function properly, or when the material is applied incorrectly or carelessly. Below is a guideline for basic Do’s and Don’ts.

## General Guidelines for Joint Designs

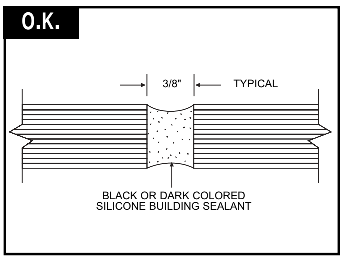



1. Dimensions C an A must be at least 1/4".
2. Ratio of A:B should be 2:1 minimum.
3. Joint surface tooled concave.
4. Dimension B suggested maximum = 3/8".

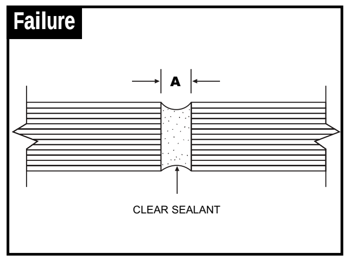



1. A deep sealant joint will not have the same movement capability as a properly designed joint.
2. Slow cure due to excessive sealant depth.

## Butt Joint Glazing

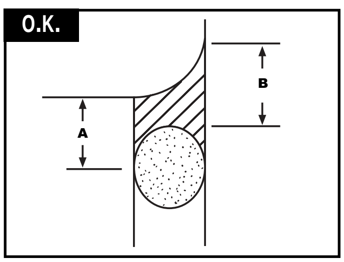



1. Minimum 1/4" joint width.
2. Minimum 1/4" glass thickness.
3. Joint tooled into hourglass shape.
4. Dark-colored silicone building sealant is recommended.

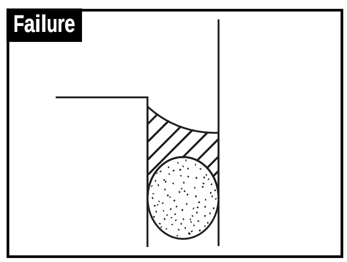



1. Dimension A less than 1/4," resulting in inconsistent joint fill and very limited movement capabilities.
2. Clear sealants susceptible to yellowing from window cleaning chemicals, intersecting organic gaskets and tobacco smoke; shows glass defects and bubbles.

## Horizontal to Vertical Joint

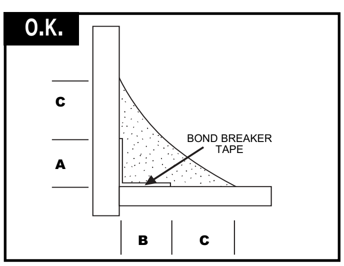



1. Dimensions A and B are both greater than 1/4".
2. Sealant tooled to ensure positive runoff of water.

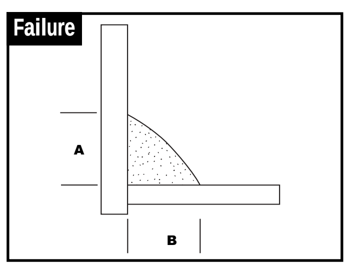



1. Water could accumulate on top of the joint, increasing the probability of joint failure.

## Moving Corner Joint

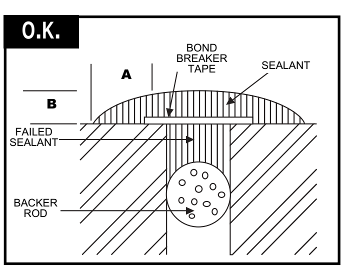



1. Dimension A, B, and C must be at least 1/4".
2. A bond breaker tape or backer rod must be present if joint movement is anticipated.
3. Joint must be tooled into a concave surface.
4. Minimum sealant thickness of 1/8"

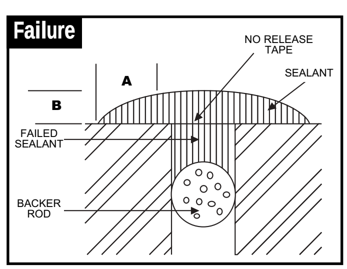



1. Dimension A or B less than 1/4".
2. Joint not properly tooled into a concave surface.
3. No bond breaker material; therefore the joint will not accept movement.

## Remedial Joints




1. Dimension A must e at least 1/4".
2. Dimension B must be at least 1/8" to a 3/8" maximum.
3. Bond breaker tape must be used to isolate fresh sealant from failed sealant.




1. Dimension A less than 1/4": difficulty in obtaining adhesion and increases the likelihood for gaps.
2. Dimension B less than 1/8": increases the likelihood of pinholes or voids in tooling; poor cohesive integrity.
3. No bond breaker tape: increases the chance that the sealant will tear when the underlying substrates move.

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