



Silicone Sealants in Construction

What Every Architect Needs to Know

Course #DE-0DC001

By: Dow Performance Silicones
(formerly Dow Corning Corporation)



Welcome to the presentation titled
“Silicone Sealants in Construction ... What
Every Architect Needs to Know.”

We will be discussing important things that
you, the architect, need to know about
silicone sealants and related silicone
coatings for the construction industry. We
will provide some basic information about
sealant types, then review different
applications for silicone sealants in
construction.

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■ Learning Objectives

Upon completion of this course, participants will be able to:

- Describe the differences between silicone and organic sealant chemistries.
- Explain the functions of nonstructural glazing sealants and select appropriate sealing systems for new construction and renovation applications.
- Explain the function of silicone structural glazing and identify appropriate applications.
- Describe appropriate designs for structural versus weathersealing sealant joints.

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Explain the functions of nonstructural glazing sealants and select appropriate sealing systems.

Explain the function of silicone structural glazing and identify appropriate applications.

Describe appropriate designs for structural versus weathersealing sealant joints.

■ Course Outline

- Sealant chemistry
- Sealant roles and properties
- Applications



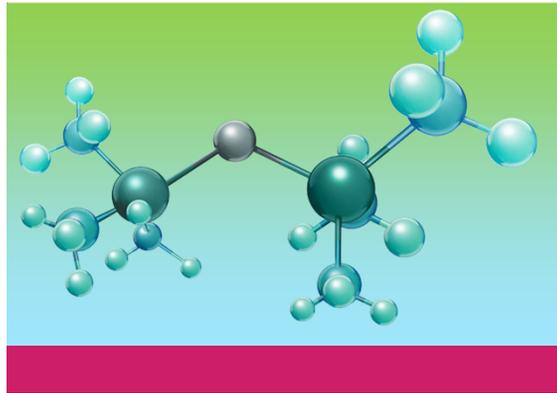
In this course, we will discuss the following topics: sealant chemistry and why it is important; sealant roles and properties, including definitions of the key terms used to describe sealant performance; and then we will discuss the many application types for silicone sealants.

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Sealant Chemistries

Two Broad Categories Available

- **Organic**, which consist of a carbon-based polymer (-C-C-O-C-C-)
 - Single-component and multicomponent polyurethane
 - Polysulfide
 - Acrylic
 - Modified silicone
- **Inorganic**, which consist of a noncarbon-based polymer (-Si-O-Si-O-Si-)
 - Silicone



We'll begin with a brief explanation of sealant chemistry. There are two broad categories of sealant chemistries available: organic and inorganic.

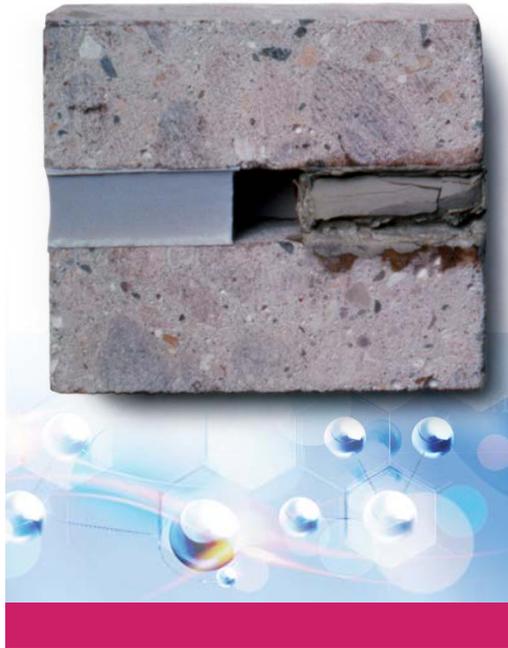
Organic sealants consist of a carbon-based polymer, so the backbone of the sealant is composed of carbon-carbon bonds. There are many types of organic sealants: polyurethanes, polysulfides, acrylics and even modified silicone sealants.

Inorganic sealants are silicones only. They are comprised of a noncarbon-based polymer and have a backbone made up of silicon-oxygen bonds or Si-O bonds. So what's the difference? As the next slide will show, in real life, there's a big difference. But since we're still talking chemistry in this slide, the difference is bond angle. The silicon-oxygen bond is approximately 30% more flexible than the carbon-carbon bond. If you think of this like your backbone, the carbon-carbon spine cannot take much twisting and movement before the bond breaks. Conversely, the silicon-oxygen bond can absorb a lot of energy, and the silicon and oxygen move around and twist without the bonds breaking.

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Why Is Sealant Chemistry Important?

- Ultraviolet (UV) light will degrade the carbon-carbon or carbon-oxygen bond of an organic sealant
- There is not enough energy in UV light to degrade the Si-O bond of a silicone sealant
- Therefore, an organic (polyurethane) sealant will degrade in sunlight, and a silicone sealant will be virtually unaffected

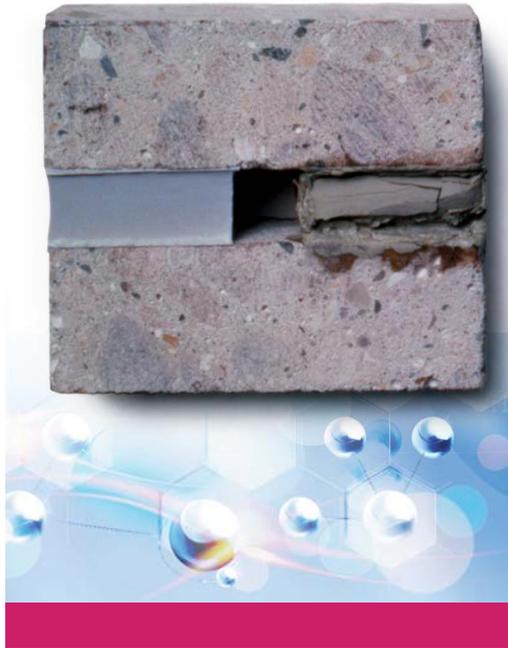


The degree of movement and the sealant's ability to absorb energy comes into play when a sealant encounters its environment. Temperature swings, UV light, different loading scenarios, but the most intense environmental factor which puts energy in to a sealant is UV light. There is enough energy in UV light to break the carbon-carbon and carbon-oxygen bonds which make up the organic sealants. In essence, the bonds holding their spines together break, because the carbon and oxygen atoms soak up the energy and start to move, and the bonds holding them together cannot stretch and move, so they break. The silicone and oxygen atoms, when exposed to the same UV light, will also start to move, but the bond energy holding together is much higher, and UV light cannot break it. So, the atoms remain bonded and the sealant remains intact. Therefore, an organic sealant will degrade in sunlight, whereas a silicone will be virtually unaffected.

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Why Is Sealant Chemistry Important? (continued)

- Ultraviolet (UV) light will degrade the carbon-carbon or carbon-oxygen bond of an organic sealant
- There is not enough energy in UV light to degrade the Si-O bond of a silicone sealant
- Therefore, an organic (polyurethane) sealant will degrade in sunlight, and a silicone sealant will be virtually unaffected



The picture shows a silicone sealant next to a polyurethane sealant and the sample has been artificially weathered for 2,400 hours, which is equivalent to approximately 3 to 6 years in outdoor conditions, depending on the severity. In high UV exposure climates such as Las Vegas and Phoenix, this may represent an even shorter field exposure time. As you can see, the organic sealant – a polyurethane in this case – degrades while the silicone remains unaffected. This is because the silicone-oxygen backbone of the silicone sealant can absorb the energy from the UV light while its bonds remain intact. The organic bonds are not able to do this. The energy breaks the bonds, resulting in the degraded sealant. This is just chemistry and physics, and it is unavoidable. All the additives in the world cannot change the fact that carbon-carbon and carbon-oxygen bonds just cannot absorb nearly the energy that a silicone-oxygen bond can. When the polymer backbone is less able to absorb energy, it is not going to be as durable in exterior environments where it is being bombarded by energy from UV light and temperature swings.

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U.S. Steelworkers Building in Pittsburgh

Original silicone sealant installed 40+ years ago is still performing today!



Silicone sealants have an outstanding performance track record in building construction. There are many examples of buildings throughout the world that were sealed with silicone in the '60s, '70s, and '80s and that are still performing today.

For example, this project in Pittsburgh was sealed over 40 years ago with a silicone sealant. The sealant was used to seal each of the metal-to-metal joints on the face of this spider web design. Even though it employed old acetoxy-cure silicone technology, which lacks the overall quality you find in silicone sealants today, the sealant remains rubbery and is still performing.

Today's silicone sealant technology is superior in terms of adhesion, modulus and movement capability. Nevertheless, the value of silicone for long-term performance is evident.

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■ Polyurethane Sealant Deterioration

How a polyurethane sealant deteriorates from exposure to UV light:

- Hardening
- Chalking
- Crazing
- Cracking
- Reverting



This picture further illustrates what can happen to organic sealants when exposed to UV light over time. They can harden, chalk, crack, craze or even revert. In most cases, the sealant gets stiffer as it ages. Since joint movement continues, the sealant then commonly fails cohesively or tears within itself. The photo on the right illustrates cohesive failure. As the sealant hardens, it may also put more stress on the substrate, causing adhesive failure of the sealant, substrate delamination, or spalling. The surface of the organic sealant can also chalk, craze, or crack on the surface. These surface cracks can propagate through the sealant and cause it to fail. A form of polyurethane sealant failure discovered in the 1990s is called reversion. Reversion is when the sealant becomes so badly degraded it goes back to – or reverts – to its pastelike consistency.

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What Is the Role of a Sealant?

- Stop water and air intrusion
- Accommodate differential thermal movement and other structural movements
- Coefficient of thermal expansion (in/in/°F)
 - Aluminum = 12.9×10^{-6}
 - Glass = 5.1×10^{-6}
 - Concrete = 6.5×10^{-6}
 - Polycarbonate = 38×10^{-6}



We are done with chemistry. I hope you can see how important it is to pick the sealant with the right backbone so that it will perform over time.

Now that a durable sealant has been selected, what do we want the sealant to do?

The primary purpose of a sealant is to stop water and air from infiltrating into a building.

Many different types of materials are used on a building's exterior. All of these materials have different coefficients of thermal expansion. This means that as temperature changes, the materials move at different rates. Aluminum, for example, moves at twice the rate of glass and concrete.

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What Is the Role of a Sealant? (continued)

- Stop water and air intrusion
- Accommodate differential thermal movement and other structural movements
- Coefficient of thermal expansion (in/in/°F)
 - Aluminum = 12.9×10^{-6}
 - Glass = 5.1×10^{-6}
 - Concrete = 6.5×10^{-6}
 - Polycarbonate = 38×10^{-6}



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When these materials abut each other at window perimeters and other locations, a sealant that can accommodate a range of expansion and contraction is required to keep the joints – and, subsequently, the building – air- and water-tight.

Air infiltration is the buzz in construction today, and avoiding it will lead to more energy-efficient buildings. To achieve airtight buildings, components must be sealed together and remain sealed together over time. Perhaps a little more obvious and more damaging to other components in the building, is water intrusion. Again, if a sealant loses adhesion or doesn't gain it due to improper installation or the sealant cracks or reverts as we have seen in the prior photos, and water is dripping on the expensive carpet in the penthouse suite, well... the building owner is going to hear about that right away. Depending on the extent of the exposure, the repairs for water intrusion can go far beyond fixing the sealant. For energy costs, air infiltration is definitely key, but the consequences are not quite as obvious if we don't keep water out. When it comes to keeping the components inside the building from damage such as mold and mildew, it's really important to keep water out.

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■ Important Sealant Properties

- **Adhesion** to a variety of materials
 - Primers may be required
- **Modulus** – high modulus (stiffest) to ultralow modulus (for high-movement joints)
- **Movement capability** (determined by ASTM C719)
- **Durability** when exposed to UV light, moisture and temperature extremes
 - What are the property changes?

Now that you know what you want a sealant to do, how do you go about specifying the proper sealant to ensure that it will work?

Key sealant properties include adhesion, modulus, movement capability and durability.

First, and perhaps most important, is adhesion. Every sealant, depending on its formulation, has a different adhesion profile. Certain sealants adhere better to porous substrates, while other sealants adhere better to nonporous substrates. In many cases, the sealant manufacturer will require the use of a primer to enhance a sealant's adhesion to a specific substrate.

Sealant manufacturers offer adhesion testing as part of their services to help you evaluate which sealant and primer are appropriate for which substrate. Additionally, product literature can be helpful in determining which sealants stick to which substrates. Field testing is always an option as well.

■ Important Sealant Properties (continued)

- **Adhesion** to a variety of materials
 - Primers may be required
- **Modulus** – high modulus (stiffest) to ultralow modulus (for high-movement joints)
- **Movement capability** (determined by ASTM C719)
- **Durability** when exposed to UV light, moisture and temperature extremes
 - What are the property changes?

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Modulus is important because it helps determine whether a sealant can accommodate the specified joint movement. A high-modulus sealant is a stiffer sealant. In other words, a high-modulus sealant can accommodate a high stress load with very little strain or movement. This type of sealant usually has lower movement capability. High-modulus sealants are often used where strength is important, such as in structural glazing where a sealant adheres glass to the outside of a building. A medium-modulus sealant can sometimes be used in both structural and weatherseal applications. A low- or ultra-low-modulus sealant has high movement capability, which allows the product to expand with minimal force.

Movement is usually correlated to modulus, but not necessarily. Typically, high-modulus sealants have lower movement capability, and low-modulus sealants have higher movement capability. Low-modulus sealants may have movement capability of up to +100/-50% of the original joint width. Movement capability is determined through the ASTM C719 test method.

The final important sealant property is durability. A sealant may have excellent physical properties initially, but what will happen to those properties after 5, 10 or 20 years on the building? What effect will moisture have on those properties? Also, what effect will temperature have on the sealants' movement capability and modulus?

■ Applications

- Weatherseals
- Nonstructural Glazing
- Restoration
- Precured Silicone Sealants
- Exterior Insulation and Finish Systems (EIFS)
- EIFS Restoration
- Silicone Coatings
- Sensitive Substrates
- Parking Structures
- Stadiums
- Structural Glazing
- Protective Glazing

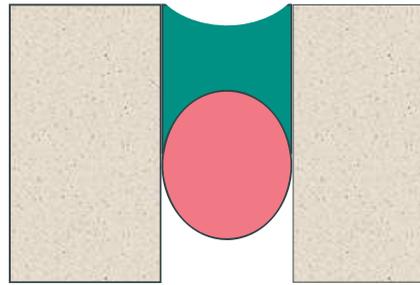


Next, we will talk about some different applications for silicone sealants and silicone coatings in the construction industry, including weatherseals, structural glazing and other topics.

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Weatherseals

- Use an hourglass-shaped butt joint for best performance
- 2-to-1 width-to-depth ratio minimum
- Maintain 1/4" contact to each joint surface
- Avoid 3-sided adhesion; use backer rod or bond breaker tape
- Other joint types: fillet joint, bridge joint, double weatherseal



But first let's discuss weatherseals and an overview of weatherseal joint design. The most basic and most common weatherseal is a butt joint between two materials as shown in the diagram. It may be an expansion joint, a perimeter seal or just a butt joint within a system between panels or glass.

The hourglass butt joint shape is effective because the sealant depth of half the joint width reduces stress on the sealant and substrate. The hourglass shape always allows for maximum contact with the sides of the joint. The other important item to consider when dimensioning a sealant joint is the substrate to sealant bond length, or sealant bite.

In all cases, there should be at least 1/4" contact on each joint surface in a moving joint. Also, the sealant should be installed to allow adhesion to only the two sides of the joint and not the back of the joint. Backer rod or bond breaker tape can be used to prevent three-sided adhesion.

Other common joints include: fillet joints, where two perpendicular joints abut each other; bridge joints, which are typically used for restoration over failed weatherseals; and double weatherseals, commonly used in modern commercial construction.

Joint Design Basics

- Minimum depth of 1/4" sealant/substrate bond to ensure adequate adhesion
- Minimum width of 1/4" opening to ensure sealant flow into joints
- Ensure joint design allows moisture from environmental humidity access to one-part silicone sealants for full cure



Sealants are designed to perform when installed in compliance with accepted weathersealing procedures. Industry guides documenting in detail the procedures for designing weatherseal joints are available. We will provide some examples in this presentation.

A few underlying principles are critical to consider in virtually all joint designs using silicone sealants. This section is intended as a review of these underlying design principles.

In all cases, a minimum depth of 1/4" sealant/substrate bond is necessary to ensure adequate adhesion.

In most cases, a minimum width of 1/4" opening is necessary to ensure that sealant applied from a caulking gun will flow into the sealant joints. In some cases where the sealant is used simply as a nonmoving bedding compound and is applied to one substrate before both substrates are pressed together, thinner joint dimensions are acceptable.

One-part silicone sealants require atmospheric moisture to fully cure. Therefore, the sealant joint must be designed to ensure that the sealant is not isolated from the air.

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■ Design of Moving Joints

- A minimum 1/4" joint width is recommended
- Eliminate three-sided adhesion using a bond breaker tape or backer rod
- A properly designed moving joint with a 2:1 width to depth ratio will accommodate more movement than a thick joint
- As the sealant joint width becomes larger than 1", the depth should be held at approximately 3/8" to 1/2" at maximum
- Joint widths up to 4" can be accommodated with silicone sealants

For moving joints, the following items should also be considered.

A minimum 1/4" joint width is recommended. Wider joints accommodate more movement than narrow joints.

Three-sided adhesion limits the amount of movement that a joint can accept without inducing a tear. Three-sided adhesion can be eliminated by the addition of a bond breaker tape or backer rod. With three-sided adhesion, no more than $\pm 15\%$ movement can be accommodated.

A properly designed moving joint with a 2:1 width to depth ratio will accommodate more movement than a thick joint (i.e., a 1.5:1 or 1:1 ratio). Sealants are designed to deliver optimum performance when the joints are shaped like an hourglass and use the 2:1 ratio.

As the sealant joint width becomes larger than 1", the depth should be held at approximately 3/8" to 1/2" maximum. There is no need for greater sealant depth with a silicone sealant. This may mean that the width to depth ratio will be greater than 2:1 (i.e., 3:1).

■ Design of Moving Joints (continued)

- A minimum 1/4" joint width is recommended
- Eliminate three-sided adhesion using a bond breaker tape or backer rod
- A properly designed moving joint with a 2:1 width to depth ratio will accommodate more movement than a thick joint
- As the sealant joint width becomes larger than 1", the depth should be held at approximately 3/8" to 1/2" at maximum
- Joint widths up to 4" can be accommodated with silicone sealants

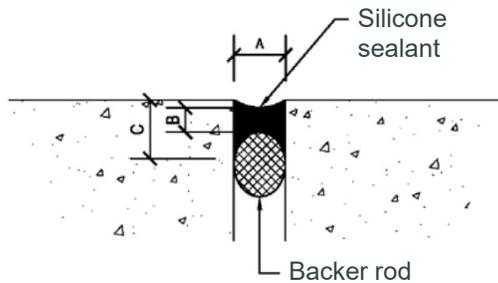
Joint widths up to 4" can be accommodated with silicone sealants. Wide joints may require additional care and attention to detail to provide an aesthetically pleasing finish. Wider joints may be better accommodated by use of precured silicone strips.

Although wider joints can be installed, it is much more difficult to install them correctly without the sealant sagging or wrinkling. A guideline is that the sealant depth in the middle of the joint is approximately half the sealant width, up to 1" in width. For wider joints, the sealant depth should still be maintained at no more than one half of an inch. This is important so that the joint movement capability of the sealant is maintained. If you imagine holding a rubber band between your thumb and forefinger and stretching it, it is fairly easy to do. Now double the rubber band on itself, making it thicker, and it is harder to pull on. If you fold it over again, it will become thicker and so on, because it is in effect, deeper. The rubber band hasn't changed in composition, but its depth can affect its ability to move. Sealants are the same way; the thicker the joint, the less movement it will have, so it should not be deeper than 1/2". The minimum depth at the joint center then is 1/8" for a 1/4" wide joint, but remember ... 1/8" depth is used at the center; 1/4" bite or contact on the substrate must still be maintained.

Typical Joint Designs

Conventional Moving Weatherseal

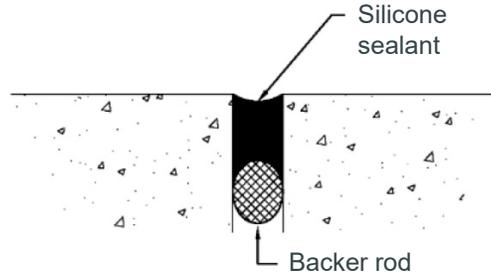
Good Joint Design



Good Joint Design – Key Points:

1. Dimension A must be at least 1/4" (6 mm).
2. Dimension B must be at least 1/8" (3 mm).
3. Dimension C must be at least 1/4" (6 mm).
4. Ratio of A:B should be 2:1 minimum.
5. Joint surface tooled.
6. Dimension B suggested maximum = 1/2" (12.7 mm).
7. Dimension A maximum = 4" (100 mm). Joints wider than 2" (50 mm) may slump slightly; therefore, double application techniques of the sealant may be required.

Poor Joint Design



Poor Joint Design – Concerns:

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.

On the next few slides, we'll look at some typical weatherseal joint designs and some of the key points differentiating good and bad designs.

We'll begin with a conventional moving weatherseal joint, which is designed to accommodate typical expansion/contraction and substrate movement.

Key points for a good joint design include:

Dimensions that meet minimum joint requirements. In this case, a joint width of at least 1/4", joint depth of at least 1/8", with a ratio of the width to depth being at least 2:1.

The joint surface should be tooled.

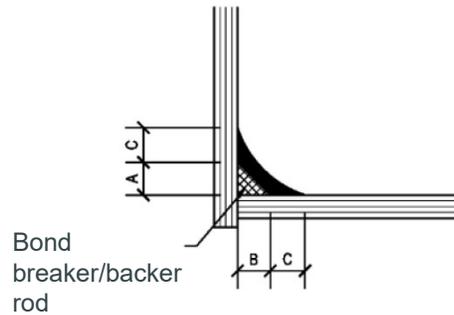
The joint depth should not exceed a 1/2" maximum, and the joint width should not exceed a 4" maximum. Joints wider than 2" may slump slightly; therefore, double application techniques of the sealant may be required.

Comparatively, common mistakes in a moving weatherseal design are illustrated with the "Poor Joint Design" detail. A deep sealant joint will not have the same movement capability as a properly designed joint, and excessive sealant depth will cause slow sealant cure.

Typical Joint Designs

Moving Corner Joints

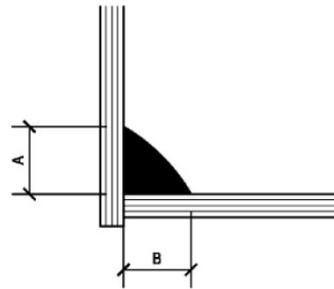
Good Joint Design



Good Joint Design – Key Points:

1. Dimensions A and B must be at least 1/4" (6 mm).
2. A bond breaker tape or backer rod must be present if joint movement is anticipated.
3. Joint must be tooled flat or slightly concave.
4. Dimension C must be at least 1/4" (6 mm).

Poor Joint Design



Poor Joint Design – Concerns:

1. Dimension A or B less than 1/4" (6 mm).
2. Joint not properly tooled.
3. No bond breaker material; therefore, the joint will not accept movement.

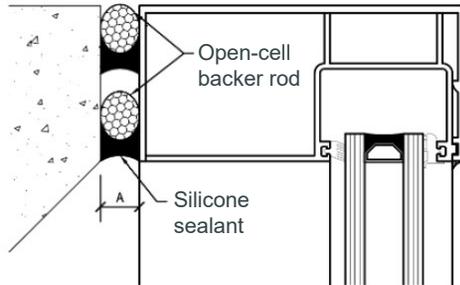
With a moving corner joint, use of a breaker tape or backer rod is critical to enable joint movement. The break material should be at least 1/4" in thickness as shown by dimensions A and B on the illustration. Similarly, the sealant should be at least 1/4" deep (shown by dimension C) and should be tooled flat or slightly concave.

Factors contributing to a poor joint design include insufficient depth of backer materials, improperly tooled sealant or complete lack of a backer material – which negates the movement capability of the joint.

Typical Joint Designs

Dual-Seal Moving Weatherseal

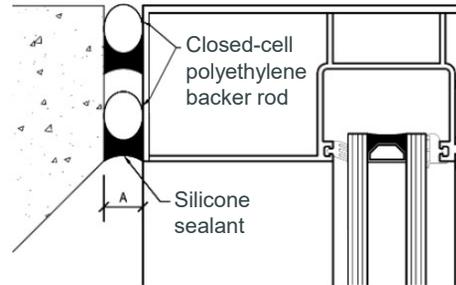
Good Joint Design



Good Joint Design – Key Points:

1. Both weatherseals comply with the requirements for conventional moving weatherseals (addressed previously).
2. Open-cell backer rod is used to ensure full cure of the back weatherseal.
3. If closed-cell backer rod is used, the back weatherseal must be fully cured prior to the installation of the exterior seal.
4. Dimension A is at least 3/4" wide to assist application of the rear sealant joint.

Poor Joint Design



Poor Joint Design – Concerns:

1. If both joints are sealed at or near the same time, the closed-cell backer rod will prevent moisture from reaching the rear sealant joint, and the sealant will not cure.
2. Dimension A is less than 3/4", making application of rear joint difficult.
3. Exterior joint seal to aesthetic snap-on cap.

In the dual-seal moving weatherseal, both weatherseals must comply with the requirements for conventional moving weatherseals as we previously discussed.

An open-cell backer rod – which will enable moisture vapor to pass through – is used to ensure full cure of the back weatherseal. If closed-cell backer rod is used, the back weatherseal must be fully cured prior to the installation of the exterior seal.

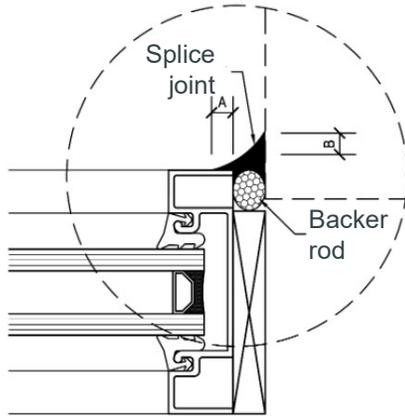
It is recommended that the joint width (dimension A) be at least 3/4" wide to assist application of the rear sealant joint.

Some typical concerns that can lead to poor joint performance are indicated by the "Poor Joint Design" detail. If both joints are sealed at or near the same time and a closed-cell backer material is used, the closed-cell backer rod will prevent moisture from reaching the rear sealant joint, and the sealant will not cure. Use of a narrower joint width (dimension A less than 3/4") can make application of the rear joint difficult and contribute to installation problems. And an exterior joint seal to aesthetic snap-on cap.

Typical Joint Designs

Window Perimeter Joints

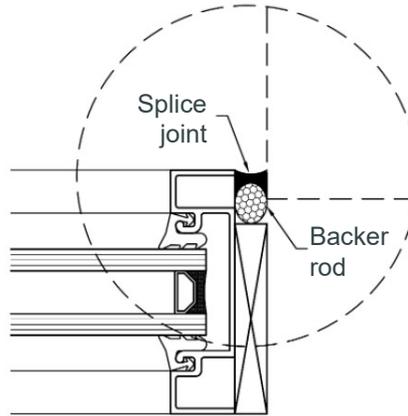
Good Joint Design



Good Joint Design – Key Points:

1. Dimensions A and B are each 1/4" (6 mm) or larger.

Poor Joint Design



Poor Joint Design – Concerns:

1. Attempting to apply sealant onto the edge of (or behind) thin-gauge metal results in inadequate sealant/substrate contact and water leakage.

In window perimeter joints, it's critical to allow 1/4" of sealant bite on both the aluminum extrusion and the substrate.

Attempting to apply sealant onto the edge of (or behind) thin-gauge metal results in inadequate sealant/substrate contact and water leakage.

Sealant Installation

- Clean – clean, dry, frost-free substrates
- Prime as recommended by the sealant manufacturer
- Install backer material sized 25% larger than the joint
- Install sealant and tool
- Perform field adhesion testing – document in quality assurance log



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Now we will talk about proper sealant installation. We spend hours on this topic when training sealant installers or contractors, but this will be a quick overview today. The biggest take-away here is that sealant installation is critical. You can specify the perfect sealant, but improperly installed, it can lose adhesion, and the water and air comes flowing into the building. When we are called to look at sealant issues, it is generally related to improper installation.

Proper installation of sealant requires that certain steps be followed. These are the big six of sealant installation: Clean, prime, back the sealant, install the sealant, tool the sealant and check your work.

First, the substrate must be clean, dry and frost-free. Depending on the substrate, this may require abrasion or solvent cleaning.

Priming is then done for certain sealant/substrate combinations. There are many types of primers, including film-forming primers and chemical treatment primers which penetrate instead of forming a film. The correct primer must be used. Refer to the sealant manufacturer's guidelines.

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Sealant Installation (continued)

- Clean – clean, dry, frost-free substrates
- Prime as recommended by the sealant manufacturer
- Install backer material sized 25% larger than the joint
- Install sealant and tool
- Perform field adhesion testing – document in quality assurance log



After cleaning and priming, a backer material is installed. The backer rod allows the sealant to be installed and tooled properly and provides a proper joint shape. The backer rod should be sized at least 25% larger than the joint.

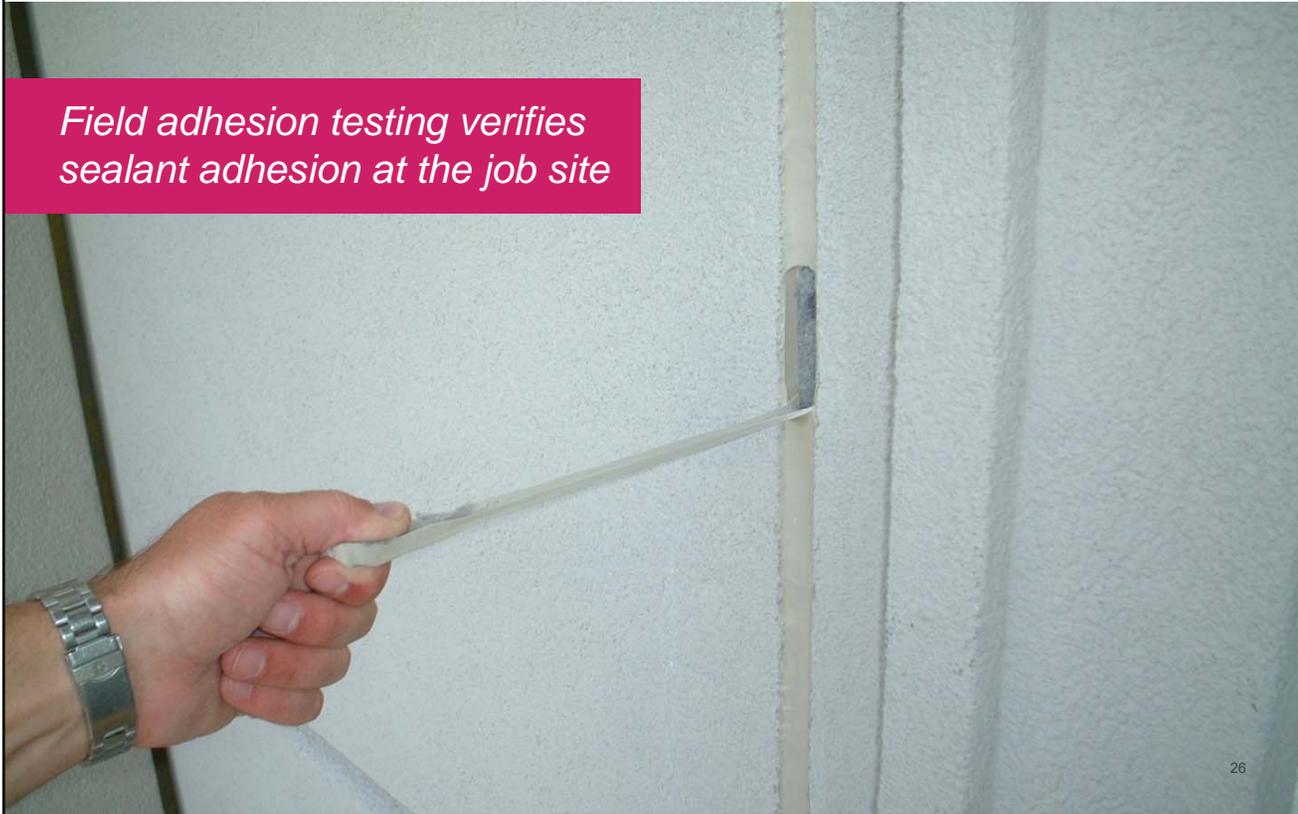
The sealant is then installed and tooled. The sealant should completely fill the joint. Tooling ensures that the joint is filled to the proper joint shape and that the sealant wets out the sides of the joint.

Finally, field adhesion testing is performed on the sealant one to two weeks after it has been installed to ensure full adhesion.

(dow_45465661813, dow_45465661454, dow_45465661252, dow_45465662502, dow_45465662841)

Sealant Installation: Adhesion Testing

Field adhesion testing verifies sealant adhesion at the job site



Field adhesion is simple to do and ensures things are being installed correctly and consistently.

This picture shows a field adhesion test being performed on an ultra-low-modulus sealant installed in an EIFS-to-EIFS joint. In this case, a tab is pulled one inch from where it is cut. You can see the extreme elongation characteristics of this product.

Each sealant has different pass/fail criteria. Some sealants require a certain percent elongation, while others require cohesive failure of the sealant. Each manufacturer should publish its pass/fail criteria. Field adhesion tests should be conducted at the start of the job and throughout the project to verify sealant adhesion and to track the workmanship of the contractor.

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■ Nonstructural Glazing

- Glass-to-glass butt joints
- Silicone cap beads
- Wet sealing
- Internal seals
 - End dams
 - Screw heads
 - Splice joints



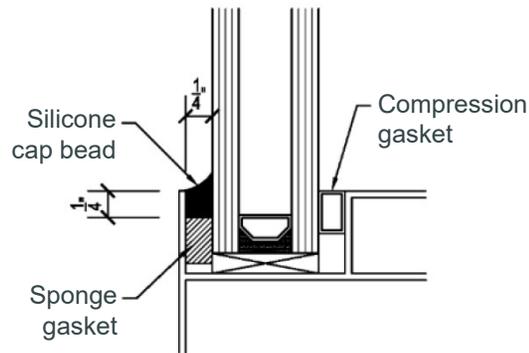
Other weatherseal applications include nonstructural glazing applications, such as glass-to-glass butt joints, silicone cap beads from the glass to the window frame and internal seals in the window system. These seals are often overlooked but are very critical. They ensure that the window drainage system can effectively control water when it enters the window system. Silicone is the best product to provide long-term window drainage system performance.

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Typical Glazing Joint Designs

Silicone Cap Beads

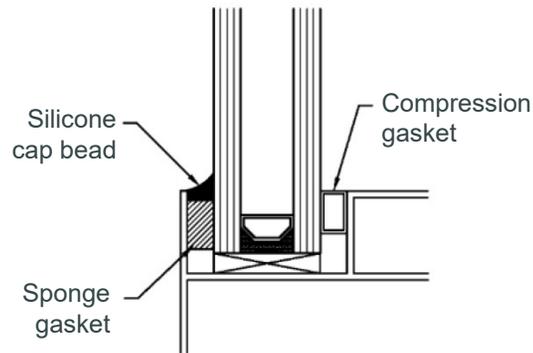
Good Joint Design



Good Joint Design – Key Points:

1. Adhesion contact on glass and metal is at least 1/4" (6 mm).
2. Silicone is compatible with gasket.
3. Dark-colored sealant masks possible discoloration from the gasket.

Poor Joint Design



Poor Joint Design – Concerns:

1. Inadequate contact between sealant and external metal.
2. Gray sealant is prone to discoloration.

On the next two slides, we'll discuss some suggestions for good glazing joint designs.

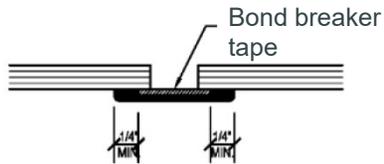
Like most joint designs, a key point for cap bead glazing joints is to ensure adequate adhesion contact area. A minimum contact area of one quarter inch is recommended on the glass and metal areas. It is also critical that the chosen silicone is compatible with the gasket material. Additionally, use of a dark-colored sealant will mask possible discoloration from the gasket.

Typical concerns encountered in poorly designed joints are inadequate contact between the sealant and the external metal. Use of lighter, gray sealant is prone to discoloration.

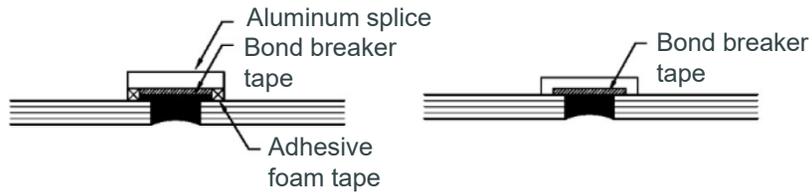
Typical Glazing Joint Designs

Splice Joints

Good Joint Design



Good Joint Design



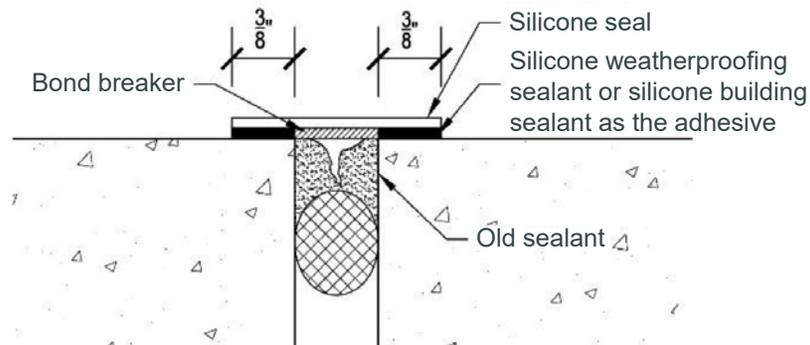
Poor Joint Design



Key Points:

1. Joint is very difficult to clean.
2. Bond breaker hard to position/size correctly.
3. Movement during cure can cause joint failure.

Best Joint Design



Regardless of their apparent simplicity, splice joint designs have a number of challenges. They can be very difficult to clean, the bond breaker can be hard to position/size correctly, and movement during cure can cause joint failure.

Take particular care to address these concerns, and ensure adequate sealant contact area, ideally 3/8" or greater beyond the bond breaker material.

In the "Best Joint Design" figure shown here, the splice joint is used as a remedial seal to replace existing failed sealant.

Restoration

- Remove failed sealant down to original surface
- Install test joints before starting the restoration project
- Wet seals – to replace failed gaskets
- Bridge joints
 - Wet sealants
 - Precured sealants



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For restoration work, a step has to be added to the installation process. The old sealant must be removed, or it may be decided to cover over it. If removed, there could be a cutting or grinding step before cleaning depending on the condition.

For example, to restore joints containing failed polyurethane sealant, we recommend complete removal of the failed sealant. We do not want to rely on adhesion on a failed, poorly performing product. This may mean grinding the joint surfaces down to the original substrate or cutting the sealant out and abrading the substrate with something like Scotch-Brite™ may be sufficient.

Each job and condition is unique, so we recommend a mock-up for restoration projects, in which field adhesion tests be performed on a representative substrate to verify first that the substrate preparation method has worked, and secondly to determine if a sealant will adhere with or without primer.

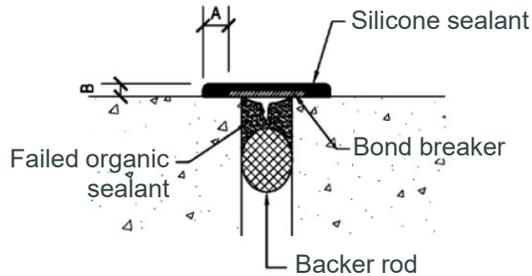
Another common restoration application is the use of wet seals from the window frame to glass. The use of fillet beads and bridge joints should be used at all window joinery to prevent water from entering the window system. Bridge joints can be produced with wet sealant or precured sealant

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Restoration

Bridge Joints – Wet Sealants

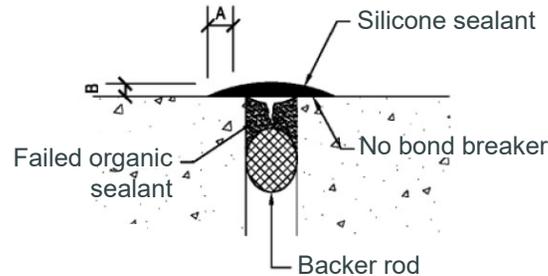
Good Joint Design



Good Joint Design – Key Points:

1. Dimension A must be at least 1/4" (6 mm).
2. Dimension B must be at least 1/8" (3 mm).
3. Bond breaker tape must be used to isolate fresh sealant from failed organic weatherseal and to allow joint movement.
4. If existing sealant has not lost adhesion to the substrate, disengage it before applying silicone sealant.

Poor Joint Design



Poor Joint Design – Concerns:

1. Dimension A less than 1/4" (6 mm) increases difficulty in obtaining adhesion and increases the likelihood for voids.
2. Dimension B less than 1/8" (3 mm) increases the likelihood of pinholes or voids in tooling; poor cohesive integrity.
3. No bond breaker material; therefore, the joint will not accept movement.

While we previously showed a splice joint detail used in a remedial application, we'll now look more in-depth at remedial joint designs.

Again, it is very important that sufficient sealant contact area is used. At least 1/4" is recommended, as shown in Dimension A on the detail. The sealant thickness (shown as dimension B) must be at least 1/8" in depth.

To isolate the fresh sealant from failed organic weatherseal and to allow joint movement, a bond breaker tape must be used. If the existing sealant has not failed completely or lost adhesion to the substrate, it should be disengaged from the substrate before applying the new silicone sealant.

Concerns arising from poor joint designs are similar to those previously discussed. A lack of appropriate sealant contact area increases difficulty in obtaining adhesion and increases the likelihood for voids. Too thin of sealant application – say, less than 1/8" thickness, increases the likelihood of pinholes or voids in tooling and may exhibit poor cohesive integrity. With a lack of bond breaker material, the joint will not be able to accommodate movement.

■ Precured Silicone Sealants



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Precured silicone sealants were introduced in the early 1990s as an innovative way to restore failed polyurethane sealant joints. These products are applied on the face of the joint adjacent to the existing sealant joint. Normally, the existing sealant does not need to be removed.

First, the substrate is cleaned as the manufacturer recommends. A silicone sealant is applied in a uniform bead adjacent to the joint.

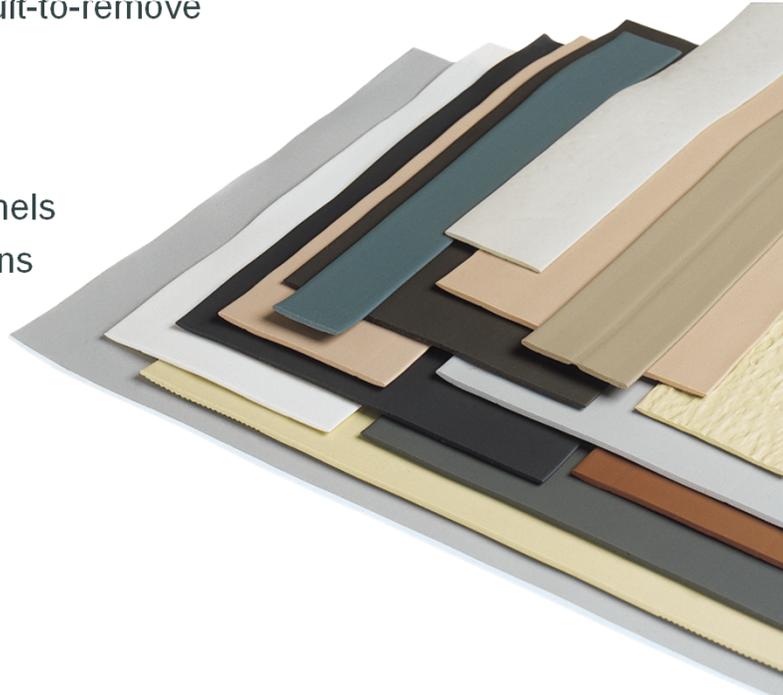
Next, the strip of precured silicone sealant is pressed into the wet sealant. The contact areas should be at least 3/8" once the wet sealant is compressed. Once the sealant is cured, it chemically bonds to the substrate, as well as to the precured silicone sealant strip.

Precured silicone sealants are available in a variety of standard and custom colors, in widths from 1 inch to 12 inches. They can be textured to blend with substrates such as stucco or EIFS, and notched to allow the strips to conform easily around corners.

(dow_40422822508)

■ Precured Silicone Sealants

- Weatherseals over difficult-to-remove polyurethane sealant
- Glazing splice joints
- Roof parapet caps
- Aluminum composite panels
- Custom silicone extrusions and molded designs now available

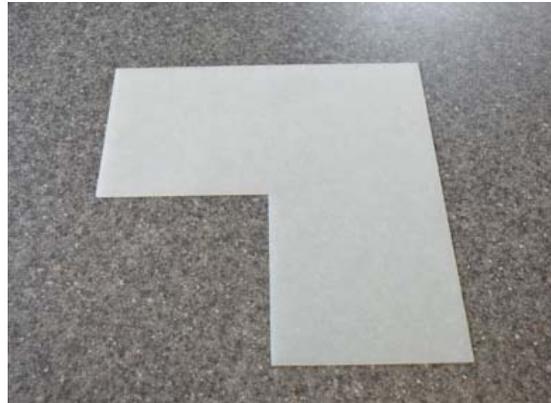
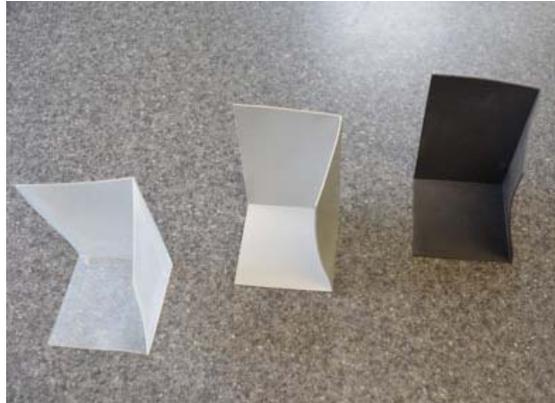
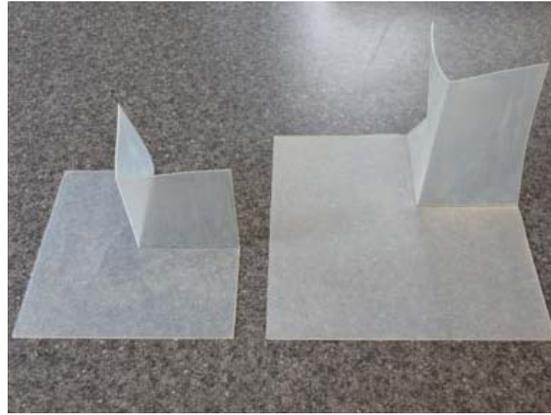
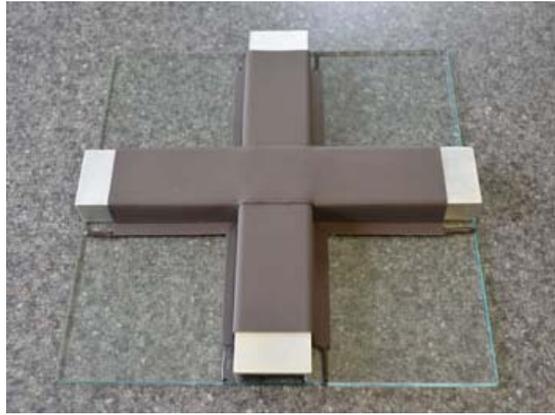


Precured silicone sealants have many applications. These products have found acceptance in joints where the original failed polyurethane sealant has reverted or is very difficult or costly to remove.

This product can be used in difficult-to-seal joints, such as splice joints in window systems or on roof parapet caps.

Custom extrusions and molded precured silicone sealant designs also have been introduced.

(dow_40176310440)



Custom extrusions and molded procured silicone designs have also been introduced.

Shown are examples of some of the different shapes and designs that can be created. These materials can be formed into molded boots or extrusions, then adhered with silicone sealants. These products have found acceptance in new construction for curtainwall designs, as well as in restoration applications.

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■ Exterior Insulation and Finish Systems (EIFS)

- EIFS is a softer substrate requiring sealants that produce less stress on the substrate
- Silicone sealants offer long-term durability, high movement capability and low modulus, particularly in cold temperatures



EIFS is a substrate that offers some unique challenges to the sealant manufacturer. EIFS is a soft substrate; as a result, selection of the right sealant is critical to the material's performance.

Silicone sealants have been broadly accepted for use with EIFS because silicone offers long-term durability, high movement capability and low modulus, particularly in cold temperatures.

As you will see on the coming slides, sometimes EIFS is the perfect candidate for bridge joints using the cured silicone strips we have been discussing.

(dow_40646058884)

■ Exterior Insulation and Finish Systems (EIFS)

- EIFS coating delamination can be caused by the stiffness of the sealant
- A low-modulus silicone sealant applies less stress to the substrate



Proper sealant properties are important when sealing EIFS in new construction.

This picture shows what a high-modulus sealant can do to EIFS. It can cause the EIFS coating to delaminate. A sealant that is low-modulus and stays low-modulus when it is cold is much less likely to cause this problem.

(dow_40644201957)

EIFS Joint Restoration

- EIFS joint restoration is complex due to the difficulty in removing failed polyurethane sealant without damaging the EIFS substrate
- The use of a precured silicone sealant bridge joint and silicone elastomeric coating offers a cost-effective, aesthetically pleasing, watertight solution



EIFS coatings and mesh can be easily damaged if a grinder is used to remove the failed sealant. A solution that is gaining broad acceptance is the use of a precured silicone sealant bridge to span the failed joint. The entire EIFS wall, including the precured silicone sealant, can then be coated with a silicone elastomeric coating to provide a cost-effective, aesthetically pleasing watertight wall.

(dow_40355051559)

■ Silicone Elastomeric Coating

- Water-based, one-part silicone emulsion
- 50% solids by weight
- Easily applied by roller, brush or spray
- At least 10 mil dry film thickness
- VOC compliant



A silicone elastomeric coating is a water-based emulsion of silicone polymer. This product is similar to other acrylic elastomeric emulsions, except the polymer is silicone instead of acrylic. Like other elastomeric coatings, silicone elastomeric coating is 50% solids by weight and can be easily applied by roller, brush or spray. The coating is applied to a dry film thickness of 10 mils. Being water-based, the coating is VOC compliant.

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■ Silicone Elastomeric Coating

- Long-term silicone flexibility
- High permeability (average 43 metric perms at 10 mil dry film thickness)
- Suitable for use on concrete, stucco, EIFS, brick



The coating offers long-term silicone flexibility. Silicone is also inherently very permeable, and aside from its durability, this permeability is what makes the coating very unique. By being highly permeable, the coating allows water in vapor form only to easily permeate the coating. But the coating, as it is a continuous solid layer when applied, repels water in its liquid form. Thereby, if the coating is applied to a wet wall, there will be vapor drive for water to want to leave that wall. It can pass easily through a permeable coating. However, more liquid water form the outside will not penetrate. So, by coating a building with a silicone elastomeric coating, you can actually dry it out.

What does 43 perms really mean? To translate it into something useful, this means about 8 ounces of water in vapor form per square yard per day can escape through the coating. Conversely, other coating technologies with lower perm rates will not allow this much moisture to escape. This can create bubbles, blisters and eventually tears in a coatings which are not permeable enough to allow trapped moisture to escape.

(dow_45465659841)

■ Silicone Elastomeric Coating (continued)

- Long-term silicone flexibility
- High permeability (average 43 metric perms at 10 mil dry film thickness)
- Suitable for use on concrete, stucco, EIFS, brick



Silicone is also inherently fungus- and mildew-resistant. This is particularly useful in high-humidity environments.

Silicone elastomeric coating can be used on porous substrates such as poured or precast concrete, stucco, EIFS, and brick. The coating is formulated with stable pigments to provide excellent color retention. Generally silicone elastomerics should be applied to cured concrete and cementitious products. Cure time varies but is generally referenced in the industry to be 28 to 30 days for concrete products and 7 to 10 days for thin set cementitious patch materials or stucco products.

(dow_45465659841)

■ Staining of Sensitive Substrates

- Staining is caused by nonreacted fluids in the sealant formulation
- Any sealant can stain if poorly formulated or used on a nonrecommended substrate
- Require stain testing per ASTM C1248 and a nonstaining warranty from the sealant manufacturer



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Let's switch gears now back to sealant types and some unique properties that should be considered for construction projects.

The single greatest negative voiced against silicone sealants is that they can stain a building. Staining is caused by nonreacted plasticizers or fluids in the sealant that can leach out of the sealant after it cures. Every sealant formulation, whether silicone or organic, is different. Any poorly formulated sealant can stain. For example, this building in Pittsburgh was sealed with a commercially available multi-component polyurethane sealant.

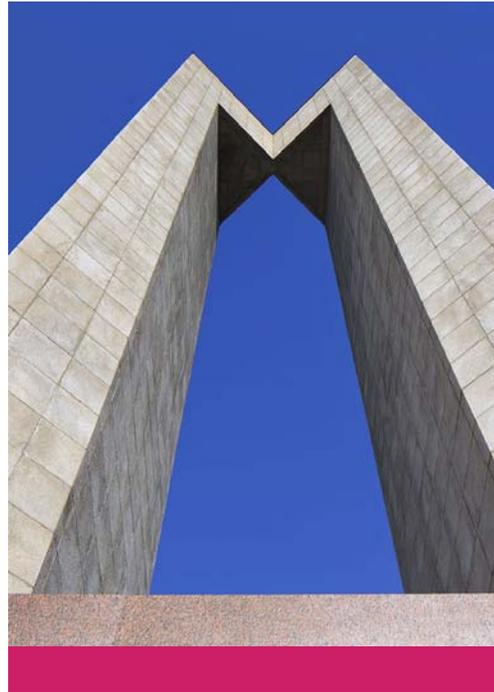
We recommend that you, as a specifier, require that the sealant manufacturer test its sealant on a sample of your project's stone in accordance with ASTM C1248. You should ask for the results and a nonstaining warranty from the manufacturer.

Please note that ASTM C510 is not nearly as stringent a test. If you want to ensure nonstaining performance, ASTM C1248 should be specified.

(dow_40452316865)

■ Clean Silicone Sealants

- Silicone sealants are available for sensitive substrates
- These sealants will not stain the most porous stone types, including Vermont and Italian white marbles
- Surface modifiers reduce dirt pickup and minimize streaking on metal panel systems



To address the staining concern, new silicone sealants that are specifically formulated for sensitive substrates have been introduced to the market. These sealants have no unreacted ingredients and have been found to be nonstaining on even the most porous marbles. Additionally, these sealants can be formulated with a special additive that imparts a smooth matte finish that helps minimize dirt pickup by the sealant. This surface then, with reduced dirt buildup on it, reduces streaking on adjacent substrates, such as metal panel systems, and keeps the building looking cleaner for longer.

(dow_41988817480)

■ Parking Structures

- Expansion joints
 - Fast-cure sealant
- Control joints
 - Self-leveling
- Cove beads
- Vertical joints
 - Nonsag sealant



Other special sealant considerations are sealants for parking structures.

Silicone sealants designed especially for parking structures are available for use in expansion joints, control joints, cove beads and vertical joints. These joints experience high UV exposure and high movement. Silicone sealants perform best under these conditions. Silicone sealants are available in two-part fast-cure formulations for dynamic joints on parking decks. For other joints, one-part self-leveling or nonsag sealants may be appropriate.

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■ Structural Glazing

- Silicone sealant adheres glass to the structure
- Sealant allows wind load to be transferred to the structure
- Sealant must be strong but flexible to accommodate thermal expansion
- Sealant must have a long life
- Only silicones can be used for structural glazing



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Next we will transition to discussing structural glazing. Now we are talking about the sealant functioning as a flexible anchor and actually adhering glass or panels to the building structure. The sealant allows for load transfer from the glass to the building structure.

In structural glazing, silicone is used primarily for its strength as opposed to its weatherseal properties. In structural glazing, the sealant serves several purposes:

- First, the sealant acts as an adhesive, adhering the glass or panel to the framing structure of the building.
- The sealant must be strong enough to allow wind load stresses on the glass or panel to be transferred to the structure.
- The sealant must be strong, but it must also be flexible to allow for differential thermal movement between the glass and metal.
- The sealant must also have proven durability.

As we discussed earlier, only silicone sealants remain unaffected by UV light and show superior durability. For these reasons, only silicone sealants can be used in structural glazing.

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Structural Glazing



4-sided silicone structural glazing

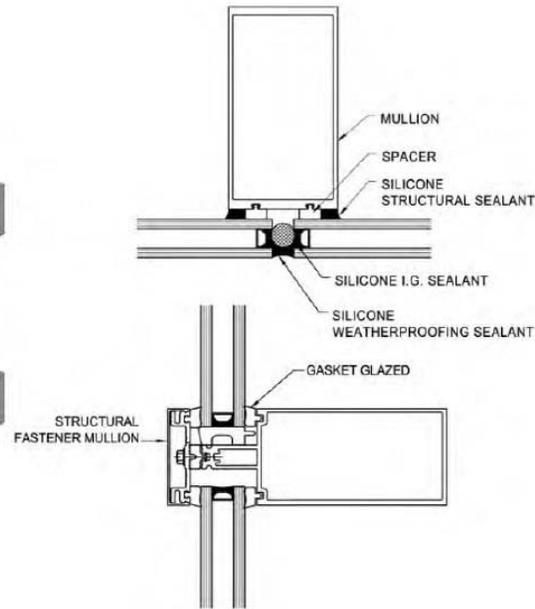
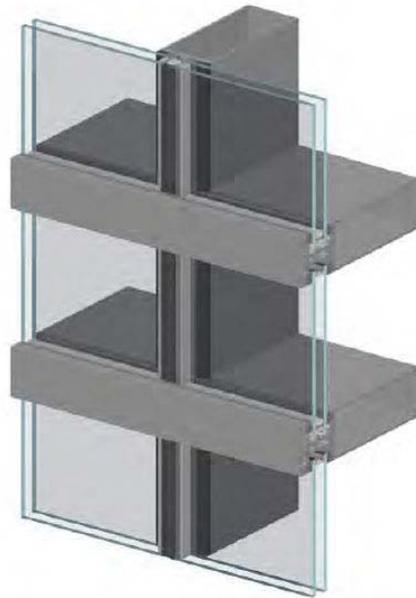


2-sided silicone structural glazing

The two major categories of structural glazing are two-sided and four-sided. The first two-sided structural glazing jobs were completed in the mid-1960s and the first four-sided silicone structural glazing jobs were completed in 1971.

Both forms of structural glazing are broadly accepted, and structural glazing has been used successfully on hundreds of buildings worldwide for more than 40 years.

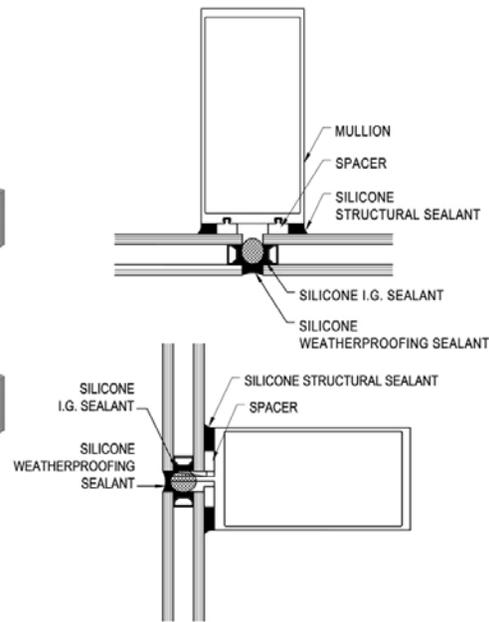
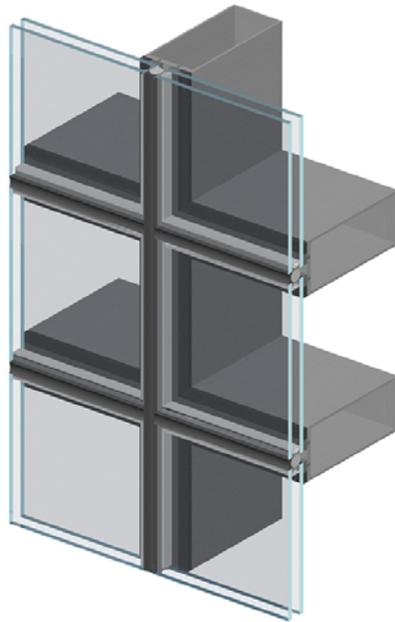
2-Sided Structural Glazing



In 2-sided structural glazing, the structural silicone is typically used to attach either the vertical or horizontal edges of the glass. The 2 remaining edges are conventionally glazed, with metal and gaskets being used to attach the glass from the outside.

2-sided structural glazing can be fabricated in the factory or on-site.

4-Sided Structural Glazing

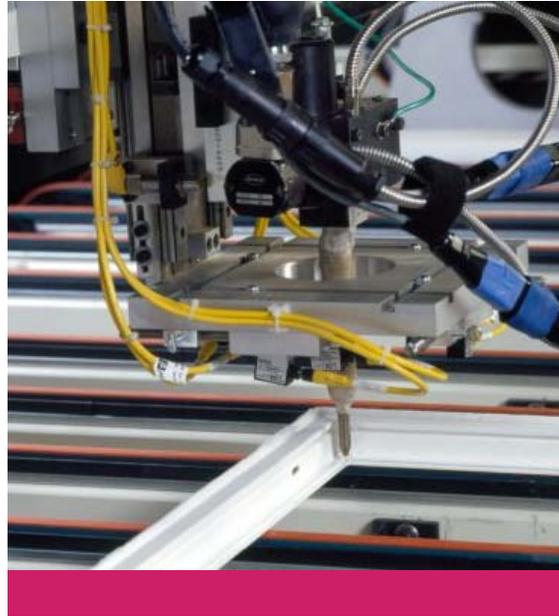


Glass is supported on all 4 sides with structural silicone.

Structural silicone is used for bonding all 4 edges of the glass to the support frame, and the deadload can either be supported mechanically by a fin and setting block or by the structural silicone. It is generally recommended that 4-sided structural glazing be performed in-shop.

Application Methods

- Factory (shop) glazing
- Site (field) glazing



Application of silicone structural glazing materials is generally broken down into two methods.

The first is factory (or shop) glazing. Curtainwalls assembled in a factory environment are assembled in individual units. This system is referred to as unitized curtainwall. Factory construction of the curtainwalls provides a controlled environment where proper surface preparation and sealant application procedures can be maintained and quality control programs can be implemented and documented. After the units are assembled and sealant has been allowed to fully cure and develop adhesion, units are shipped to the construction site, where they are erected onto the building structure.

The other common method is site (or field) glazing. Site glazing is a method that applies structural sealant directly at the construction site. Panels are attached to the mullions and transoms, which are already attached to the structure. Site glazing is suitable for 2-sided structural systems, but it is generally recommended that 4-sided systems are factory-glazed.

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■ Application Methods

- Structural glass systems (bolted or point-fixed glazing)
- Total vision systems (fin glazing)
- Structural attachment of nonglass materials
- Panel stiffeners
- Protective glazing systems

There are also a number of other structural glazing application methods.

In structural glass systems (also known as bolted or point-fixed glazing), the structural glass or bolted glass system generally has holes drilled at each corner of a glass element, and a bolt is used to provide mechanical support for the glass and fixes the glass façade to a metallic structure, which is secured to the main structural member of the building. A high-quality silicone sealant is then used to provide the weatherseal between the glazing elements.

One of the latest developments in structural glass design is the elimination of the bolted system and the need to drill the glass by using structurally bonded patch plates as an alternative. Structural adhesive sealants enable the designer to do away with the cost of drilling holes in glass and the use of very expensive stainless-steel spider systems. This results in a system that has a reduced cost of manufacture, increased visibility and improved aesthetics.

Structural glass systems are often referred to as structural glazing, which is often confused with structural silicone glazing, as both techniques use this generic term. Therefore, architects and specifiers should be sure which system is being offered.

■ Application Methods (continued)

- Structural glass systems (bolted or point-fixed glazing)
- Total vision systems (fin glazing)
- Structural attachment of nonglass materials
- Panel stiffeners
- Protective glazing systems

Total vision or fin glazing is a system that is used to maximize the area of glass at the front of the building, reducing the visible mechanical fixings and increasing the unobstructed vision area of the façade. Total vision glazing is a 2-sided structural glazing system in which the glass is normally mechanically fixed at head and sill and the vertical edges are structurally attached to glass fins or mullions. The glass is bonded to the glass fin using structural silicone sealants. The structure is then made watertight using silicone weathersealing sealants. This technique is widely used for lobbies, showrooms and racetracks, where the unobstructed visibility is an advantage.

Materials other than glass have been successfully attached to buildings with silicone sealants for many years. The benefits of structural silicone have been used with materials such as thin stone panels, including granite or marble, ceramic tile, plastic, and aluminum composite materials. The durability of the nonglass material must be evaluated by the manufacturer to determine its suitability for this application.

■ Application Methods (continued)

- Structural glass systems (bolted or point-fixed glazing)
- Total vision systems (fin glazing)
- Structural attachment of nonglass materials
- Panel stiffeners
- Protective glazing systems

In panel-stiffening applications, aluminum composite materials are mechanically attached around the perimeter, and the sealant is used to attach an aluminum stiffener; glueline thickness dimensions of less than 1/4" may be permitted. In this application, there is a negligible amount of differential movement between the two aluminum components, and shear stress on the sealant is minimal. A best practice is to use a spacer material to establish a sealant joint, which can be controlled for width and thickness. Ensure use of suitable sealant for these applications by following the project specification.

Structural glazing products have successfully been used in protective glazing systems designed to meet the demands of missile impact and bomb blast testing. In missile impact testing required to withstand flying debris from hurricanes and windstorms, the glazing must stay intact through either a small or large missile impact. The sealant then must "anchor" the laminated glass through repeated wind cycles that duplicate a hurricane. For bomb blast mitigation glazing, the sealant must also anchor the laminated glass through an air blast explosion. Potential users should either test their system and have it approved or work with a bomb blast consultant who can review the design and determine the sealant requirements.

■ Structural Glazing Design Guidelines

- The structural bite must be a minimum of 1/4"
- The glueline thickness must be a minimum of 1/4"
- The structural bite must be equal to or greater than the glueline thickness
- For one-part sealant, the bite-to-glueline ratio must be between 1:1 and 3:1
- The structural sealant joint must be able to be filled using standard sealant application procedures

The following are general guidelines recommended for all structural glazing applications.

The structural bite must be a minimum of 1/4".

The glueline thickness must be a minimum of 1/4".

The structural bite must be equal to or greater than the glueline thickness.

For one-part sealant, the bite-to-glueline ratio must be between 1:1 and 3:1.

The structural sealant joint must be able to be filled using standard sealant application procedures.

■ Structural Glazing Design Guidelines

- The joint design must allow the sealant exposure to air so it can cure and obtain its ultimate physical properties
- For two-part sealant, the bite-to-glueline ratio may be greater than 3:1 with the understanding that the joint can be properly filled and the two-part materials are mixed at proper ratio during application
- The structural sealant joint must be fully cured and adhered prior to removing temporary fasteners in the field
- Before moving units in-shop, fabricators should verify that substantial cure has occurred and adhesion has been achieved

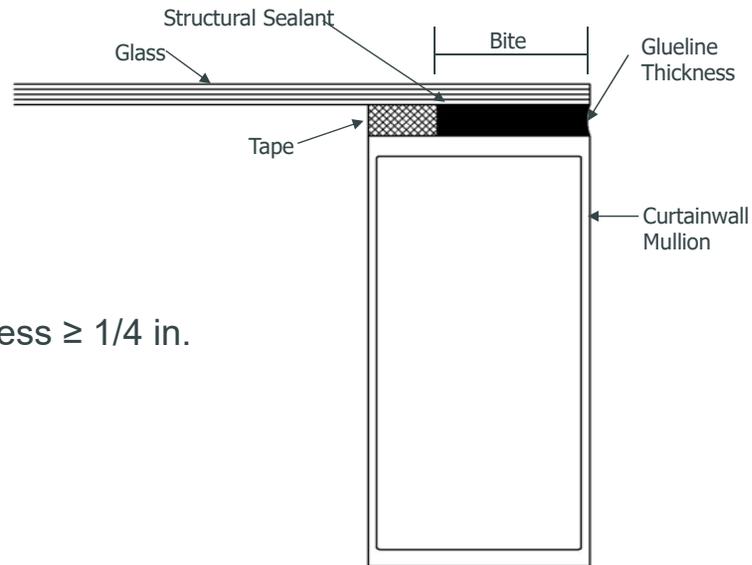
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Before moving units in shop, fabricators should verify that substantial cure has occurred and adhesion has been achieved.

Structural Glazing Design



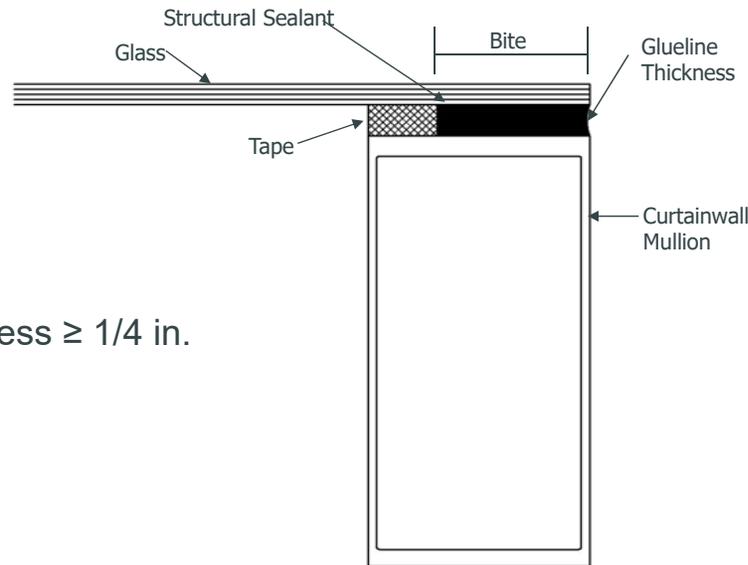
$\text{Bite} \geq \text{Glueline Thickness} \geq 1/4 \text{ in.}$

$$\text{Bite} = \frac{1/2 \text{ Glass Shortspan} \times \text{Design Wind Load}}{\text{Sealant Design Strength}}$$

The basic guidelines for structural glazing have been established for many years. The silicone acts to attach the glass during wind load. Minimum structural bite requirements have been established based on the size of the glass and the design wind load on the building. More information on structural glazing design is available from the silicone sealant manufacturer, GANA and ASTM C1401, the Standard Guide to Structural Glazing.

The basic equation for establishing the correct sealant bite is bite equals half times the glass short span times the design wind load over the sealant design strength. The sealant design strength for wind load applications is set at 20 psi by industry consensus. This does not mean that the sealants are only 20 psi in strength; this is just the design factor. Structural sealants must display at least 50 psi tensile strength when tested according to ASTM C1184, the standard specification for silicone structural glazing sealants. Many structural sealants on the market are well over 100 psi when tested to this criteria. The 20 psi design strength value is conservative and has for many years been proven in the industry to be a very safe way to design silicone structurally glazed systems.

Structural Glazing Design (continued)



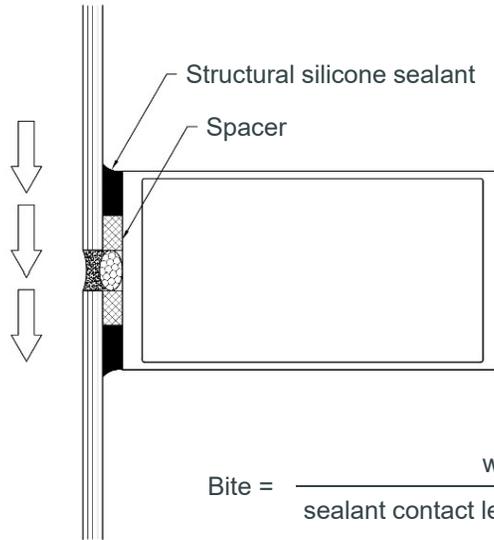
$\text{Bite} \geq \text{Glueline Thickness} \geq 1/4 \text{ in.}$

$$\text{Bite} = \frac{1/2 \text{ Glass Shortspan} \times \text{Design Wind Load}}{\text{Sealant Design Strength}}$$

The other design considerations for structural joints are that the bite must be equal to or greater than the glueline thickness and the minimum glueline thickness and therefore the bite, is 1/4". Even if the equation says that you need only 1/8" bite, that would always be rounded up to 1/4". The minimum glueline thickness is set at 1/4" to allow both proper access to install the sealant as well as to accommodate thermal and seismic movements.

Structural Glazing Design

Deadload



In unsupported deadload designs, the weight of the panel places constant load upon the sealant. Structural sealants can support the weight of the panel or glass when used within manufacturer's published guidelines.

For a structural sealant with an allowable deadload design strength of 1 psi (or 700 kg/m²), the weight of the panel divided by the total silicone contact area must not exceed 1 psi. Insulating glass unit manufacturers require deadload support for their insulating glass units.

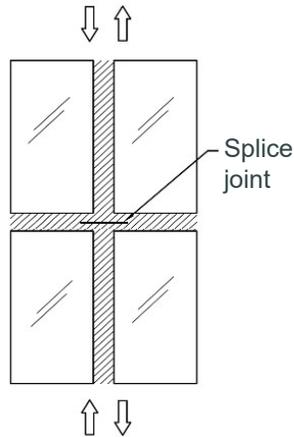
The deadload structural bite requirement is calculated by dividing the weight of glass by the sealant contact length times the sealant design strength.

Structural Glazing Design

Splice Joint in Curtainwalls

Best Design

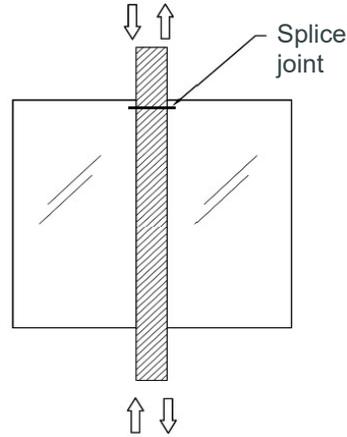
Live load and thermal movement from above



Live load and thermal movement from below

Better Design

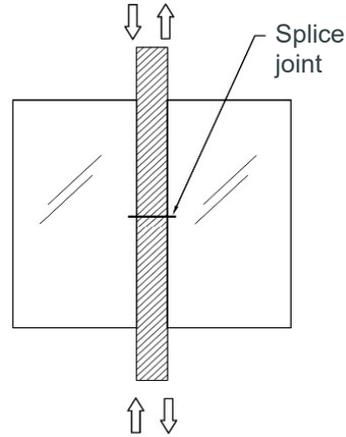
Live load and thermal movement from above



Live load and thermal movement from below

Poor Design

Live load and thermal movement from above



Live load and thermal movement from below

Splice Joints in Curtainwalls

Splice joints in aluminum curtainwall framing are the highest-movement, fastest-moving joints on a curtainwall system. Splice joints absorb the thermal expansion of 13' to 16' of aluminum framing exposed to the building's exterior on a daily basis. Field-installed stick curtainwalls use splice joints to also absorb building deflection, live loads and wind sway.

It is best to avoid splice joints within a structural joint. Placing 13' to 16' of aluminum frame thermal movement and live load deflection of the floor into the shearing of a 1/4" wide structural silicone joint will, first, exceed the design stress of the silicone, causing fatigue; second, place excessive loading onto glass, causing possible failure; or third, cause premature fogging of the insulating glass unit.

If splice joints cannot be avoided within a structural silicone joint due to the requirements of field-applied structural silicone in a stick system, then the splice joint should be applied to within 1" of the head of a piece of glass. If silicone failure occurs due to excessive joint movement, a minimum of forces will be placed onto the glass due to the placement.

■ Protective Glazing

- Building codes require the use of windows that can withstand flying debris from hurricanes or other severe weather
- Window systems that use laminated glass and a silicone sealant to anchor the laminated glass in the window frame have successfully passed the demanding missile-impact test



Protective glazing is a specialized area of structural glazing in which the sealant acts not only as a flexible anchor to undergo wind load but helps retain glass in its frame during an impact event.

As a result of events like Hurricane Andrew in 1992, protective glazing has grown in popularity. New codes require that glass openings remain intact during hurricane events. A silicone sealant is used to retain the laminated glass during missile impact and cyclic wind loads on the windows. Numerous window systems that use silicone sealants and laminated glass have successfully passed missile-impact tests.

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Blast-Resistant Glazing

- Silicone sealant is used to anchor laminated glass or a protective film in a window frame during bomb-blast testing or computer-simulated evaluations

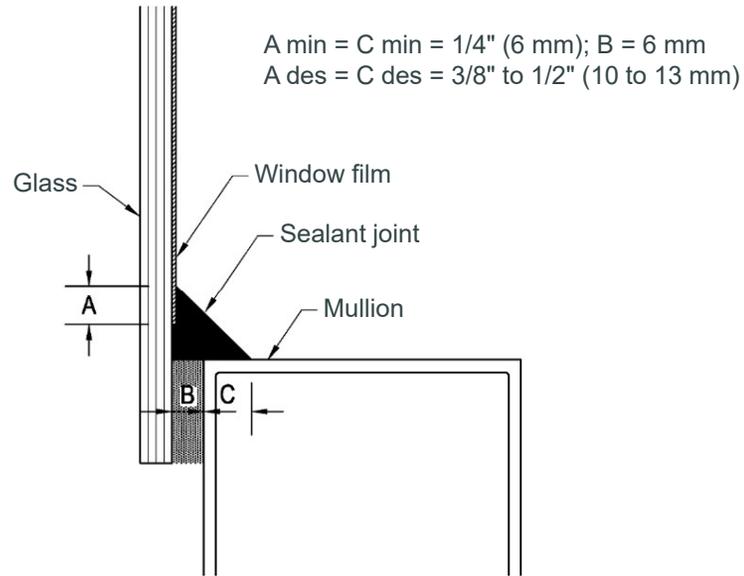


Image Courtesy of Grendon Design Agency

Blast-resistant glazing is an area that has seen significant growth since the Oklahoma City bombings and the events of 9/11. The use of silicone sealant to anchor a protective film or laminated glass can help prevent flying glass debris from entering a building and injuring people.

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Impact-Resistant Glazing Joint Design



The demands of missile impact testing are great on any sealant, which is only one component of a glazing system that includes the framing system, glass and laminate. Joints must be specifically designed to accommodate the additional requirements and stresses of this application.

References

- ASTM C719 Movement Capability Test Method
- ASTM C794 Adhesion in Peel Test Method
- ASTM C920 Standard Sealant Specification
- ASTM C1184 Structural Glazing Specification
- ASTM C1193 Guide for Use of Sealants
- ASTM C1248 Stain Test Method
- ASTM C1299 Guide for Selection of Sealants
- ASTM C1401 Guide to Structural Glazing
- ASTM C1472 Guide for Calculating Joint Movement
- ASTM C1481 Guide to Use of Sealants with EIFS

If you would like to learn more about the sealant applications we have discussed so far, here are some of the relevant standards. For copies of these standards, please visit the ASTM website at astm.org.

■ In Summary, Silicone Sealants Offer ...

- Longevity
- Versatility
- Aesthetics
- Value
- Proven performance



Silicone sealants offer longevity, versatility, pleasing aesthetics, proven performance, and above all, value. They may or may not cost more, depending on market conditions, but when you consider the cost of recaulking buildings, silicones will offer more value, every time.

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Thank You

This concludes the American Institute of Architects Continuing Education System Program “Silicone Sealants in Construction: What Every Architect Needs to Know.”

Please take the test to receive your AIA credits.

For more information, contact:

consumer.dow.com/construction



This concludes the American Institute of Architects Continuing Education System Program "Silicone Sealants in Construction What Every Architect Needs to Know".

To receive AIA credit, please complete the 10-question test.

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We are now at the point in the presentation where we can talk about Dow's silicone products for weathersealing and structural glazing applications.

■ New Brand Name Introduced: DOWSIL™

- DOWSIL™ is the new product brand name for silicone-based building products from Dow High Performance Building

DOWSIL™

silicones by 

- DOWSIL™ represents the combined power of Dow and Dow Corning
- Introduced November 2017 for Europe, the Middle East and Africa; February 2018 rollout for the rest of the world



DOWSIL™ brand Weatherseal Sealants

- **DOWSIL™ 790 Silicone Building Sealant (+100/-50%)** – ultralow-modulus expansion joint sealant; best for porous substrates
- **DOWSIL™ 791 Silicone Weatherproofing Sealant ($\pm 50\%$)** – economical, medium-modulus general weatherseal sealant
- **DOWSIL™ 795 Silicone Building Sealant ($\pm 50\%$)** – versatile industry standard for use as structural and weatherseal sealant
- **DOWSIL™ Contractors Weatherproofing Sealant ($\pm 25\%$)** – superior silicone performance at a urethane-competitive price
- **DOWSIL™ Contractors Concrete Sealant ($\pm 50\%$)** – superior primerless adhesion to most porous substrates at a urethane-competitive price



66

Silicone sealants, coatings and precured materials offer longevity, versatility, pleasing aesthetics, proven performance and above all, value. They may or may not cost more depending on market conditions, but when you consider the cost of recaulking buildings, silicones will offer more value, every time.

DOWSIL™ brand silicone sealants offer a life expectancy that's roughly three times that of organic materials in the same applications. Silicone weathersealing materials from Dow minimize nature's toll on building envelopes, as they are usually unaffected by sunlight, ozone, rain, snow or temperature extremes. They remain flexible and maintain adhesion (even while being stretched or compressed), resist cracking and tearing, and are easy to apply over a wide temperature range.

Five of our most popular weatherseal sealants that offer the proven performance of silicone include:

DOWSIL™ 790 Silicone Building Sealant
DOWSIL™ 791 Silicone Weatherproofing Sealant

DOWSIL™ 795 Silicone Building Sealant
DOWSIL™ Contractors Weatherproofing Sealant

DOWSIL™ Contractors Concrete Sealant

■ DOWSIL™ brand Weatherseal Sealants (continued)

- **DOWSIL™ 790 Silicone Building Sealant (+100/-50%)** – ultralow-modulus expansion joint sealant; best for porous substrates
- **DOWSIL™ 791 Silicone Weatherproofing Sealant ($\pm 50\%$)** – economical, medium-modulus general weatherseal sealant
- **DOWSIL™ 795 Silicone Building Sealant ($\pm 50\%$)** – versatile industry standard for use as structural and weatherseal sealant
- **DOWSIL™ Contractors Weatherproofing Sealant ($\pm 25\%$)** – superior silicone performance at a urethane-competitive price
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DOWSIL™ 795 Silicone Building Sealant also has a proven history spanning more than 40 years in structural glazing, serving as a versatile, one-part structural silicone that is widely specified and accepted among contractors and architects.

Sealants are often referred to as class 25 or class 50. These class designations indicate the movement capability of the sealant. DOWSIL™ 790 Silicone Building Sealant is an ultralow-modulus sealant that is class 100/50, indicating a movement capability of plus 100 percent, minus 50 percent. You could not have a plus 100 minus 100 sealant because the sealant cannot be compressed to nothing. Because DOWSIL™ 790 Silicone Building Sealant is ultralow modulus and has a high movement capability, it puts very little stress on the substrates around it. It is the perfect choice, then, for weak substrates such as EIFS or stucco. It is also unparalleled in its unprimed adhesion to porous substrates, especially concrete.

DOWSIL™ 791 Silicone Weatherproofing Sealant is a plus or minus 50% movement capability sealant, or medium modulus, that is an economical choice for weathersealing applications. It has excellent adhesion to metals, and Kynar™ and Duranar™ substrates in particular.

DOWSIL™ brand Weatherseal Sealants (continued)

- **DOWSIL™ 790 Silicone Building Sealant (+100/-50%)** – ultralow-modulus expansion joint sealant; best for porous substrates
- **DOWSIL™ 791 Silicone Weatherproofing Sealant ($\pm 50\%$)** – economical, medium-modulus general weatherseal sealant
- **DOWSIL™ 795 Silicone Building Sealant ($\pm 50\%$)** – versatile industry standard for use as structural and weatherseal sealant
- **DOWSIL™ Contractors Weatherproofing Sealant ($\pm 25\%$)** – superior silicone performance at a urethane-competitive price
- **DOWSIL™ Contractors Concrete Sealant ($\pm 50\%$)** – superior primerless adhesion to most porous substrates at a urethane-competitive price

As mentioned, DOWSIL™ 795 Silicone Building Sealant is a versatile medium-modulus sealant that can be used for both structural and weathersealing applications. It is one of the most specified and chosen sealants and is suitable for the widest variety of applications.

DOWSIL™ Contractors Weatherproofing Sealant and DOWSIL™ Contractors Concrete Sealant are value options offering silicone performance at urethane-competitive prices.



DOWSIL™ 756 SMS Building Sealant

- Clean sealant technology for weathersealing sensitive substrates
- One-part formulation
- Low staining potential
- Reduced dirt pickup
- Unprimed adhesion to both porous and fluoropolymer-painted substrates
- $\pm 50\%$ extension/compression capability



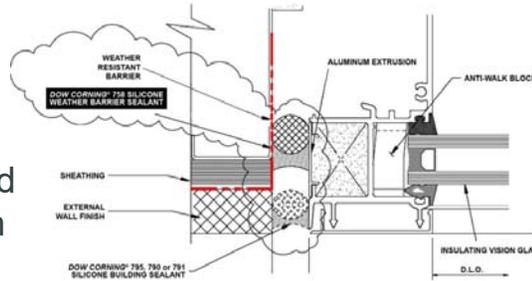
DOWSIL™ 756 SMS Building Sealant is a clean sealant developed for use with the most sensitive of stones, including Italian and white marble. Because of its completely fluid-free formulation, it also offers a cleaner surface than other silicone sealants, so not only will it not stain stone, it can be used in areas where you want to minimize dirt pick up or dirt run down. It has excellent adhesion to a wide variety of substrates.

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DOWSIL™ 758 Silicone Weather Barrier Sealant

- One-part neutral-cure sealant
- $\pm 25\%$ movement capability in properly designed joint
- Adheres to many polyethylene-film-based weather barriers, spun-bonded polyolefin and fibrous air barriers, flashing, and liquid elastomeric weather barriers
- Adheres to common fenestration substrates – anodized aluminum, vinyl, PVC and high-performance coatings
- Priming not required on most surfaces



DOWSIL™ 758 Silicone Weather Barrier Sealant has been developed specifically for adhesion to low-energy surfaces. Low energy surfaces are surfaces which are difficult to bond to, such as polyethylene and polyolefin. This is critical in today's market, as many of the air and vapor materials have these polymer facings that are difficult to adhere to. Additionally, DOWSIL™ 758 Silicone Weather Barrier Sealant adheres to almost every other surface as well. If it sticks to polyethylene, it will stick to almost anything. DOWSIL™ 758 Silicone Weather Barrier Sealant offers a sealant solution to bond window and door components to wall sections that are now covered in materials that are difficult to adhere to. There is no competitive sealant that can offer this level of adhesion and silicone durability. DOWSIL™ 758 Silicone Weather Barrier Sealant is a medium modulus sealant and has a movement capability of 25 percent and proven exterior durability. If you have a project in which an air barrier needs to be adhered to, DOWSIL™ 758 Silicone Weather Barrier Sealant is your best choice.



DOWSIL™ Parking Structure Sealants

- **DOWSIL™ NS Parking Structure Sealant** – nonsag sealant for horizontal and vertical control and expansion joints
- **DOWSIL™ SL Parking Structure Sealant** – self-leveling sealant for horizontal control and expansion joints
- **DOWSIL™ FC Parking Structure Sealant** – fast-curing, self-leveling two-component sealant for dynamic expansion joints



Dow offers three silicone parking structure sealant options: NS for nonsag applications, SL for self-leveling applications, and FC for fast-cure applications.

Nonsag is ideal for horizontal and vertical applications, while self-leveling is for horizontal control and expansion joints.

Fast cure, or FC, is ideal for situations in which a fast cure is required so that the parking deck or garage can be quickly used. FC is a two-part sealant option, while the SL and NS are one-part sealants.

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DOWSIL™ 123 Silicone Seal

- High movement (+200/-75%) for new and remedial construction
- Widths from 1" to 12"
- Available in standard and custom colors, EIFS textures and notched
- DOWSIL™ 123 Silicone Seal Custom Designs H.C. – Engineered extrusions and molded silicone pieces for new and remedial construction



DOWSIL™ 123 Silicone Seal is a preformed silicone seal with high movement capability. It is ideal for situations in which a sealant bridge is needed but would be difficult to install. Now those areas can be sealed using a precured silicone strip attached using regular liquid sealant. For example, at a parapet cap where the metal is too thin to gain the required ¼" bite, DOWSIL™ 123 Silicone Seal can be used to bridge over that joint. It can be adhered using DOWSIL™ 791 Silicone Weatherproofing Sealant, DOWSIL™ 795 Silicone Building Sealant or DOWSIL™ 756 SMS Building Sealant.

Additionally, DOWSIL™ 123 Silicone Seal can be used as a transition piece when openings need to be flashed using a flexible strip. In these applications, the DOWSIL™ 123 Silicone Seal can also be adhered using DOWSIL™ 758 Silicone Weather Barrier Sealant if an air barrier needs to be adhered to.

Custom-shaped parts also are available.

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DOWSIL™ AllGuard Silicone Elastomeric Coating

- Waterproof coating for above-grade exterior masonry substrates
- 2-coat water-based coating (10 mil DFT)
- SWRI Institute validated
- 50% solids by volume
- 10-year warranty available



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DOWSIL™ AllGuard Silicone Elastomeric Coating is a breathable, durable elastomeric waterproof coating for above-grade masonry substrates. It offers a high perm rating and all the benefits of silicone stability. It is also water-based and low in VOC content.

DOWSIL™ AllGuard Silicone Elastomeric Coating can bridge cracks up to 1/16" inch and easily applied by spray or roll. It is applied in two coats to provide a 10 mil dry film thickness.

DOWSIL™ AllGuard Silicone Elastomeric Coating has been validated by the SWRI and is backed by the assurance of an available 10-year warranty from Dow.

The coating is available in a wide variety of standard colors and custom colors are also available.

DOWSIL™ AllGuard Coating is ideal for restoration applications in which it is known the wall is leaking or has moisture problems. By putting a breathable coating on the surface, the moisture vapor trapped in the wall can escape, while DOWSIL™ AllGuard Silicone Elastomeric Coating keeps any future liquid water from penetrating.

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■ Structural Glazing Sealants

- **DOWSIL™ 795 Silicone Building Sealant** – one-component industry standard for on-site glazing
- **DOWSIL™ 995 Silicone Structural Sealant** – one-component, high-strength sealant for on-site and protective glazing
- **DOWSIL™ 983 Structural Glazing Sealant** – two-component, fast-cure, in-shop sealant for unitized curtainwall and protective glazing



Image courtesy of Senarq S A

Dow's silicone structural glazing sealant line is comprised of both one-part and two-part sealants.

DOWSIL™ 795 Silicone Building Sealant and DOWSIL™ 995 Silicone Structural Sealant are the one-part sealants for structural glazing and can be used for field or shop glazing applications. DOWSIL™ 995 Sealant is a stronger version of DOWSIL™ 795 Sealant and is ideal for impact or protective glazing applications.

DOWSIL™ 983 SGS Structural Glazing Sealant is a quick-curing two-part sealant most often used by glazing contractors for in-shop curtainwall or storefront fabrication. DOWSIL™ 983 Sealant allows the units to be moved in 24 hours rather than waiting for a one-part sealant to cure. It also has proven performance in impact applications. Although DOWSIL™ 983 Sealant could be field-applied in certain circumstances, it requires a two-part pump and many quality control processes, so it is typically used in a controlled environment.

Field structural glazing can be more easily completed with DOWSIL™ 795 Sealant or DOWSIL™ 995 Sealant. DOWSIL™ 795 Sealant or DOWSIL™ 995 Sealant may also be used for in-shop glazing, but the units must sit in place during sealant cure, so typically a two-part sealant such as DOWSIL™ 983 Sealant is preferred for in-shop glazing, so the units can be quickly moved through the shop and into the field for installation.

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DOWSIL™ 121 Structural Glazing Sealant

- Approved for structural and weatherseal applications
- Used for in-shop glazing or field repair/replacement
- Primerless adhesion to glass, alodine and anodized aluminum
- Adhesion to DOWSIL™ structural sealants for reglazing applications
- Adhesion and structural strength achieved in 24 to 48 hours
- Meets ASTM C719 Class 25 (G, A, O)
- Meets ASTM C1184 Structural Sealant Specification



Dow now offers a fast-cure, two-part silicone sealant that features an easy-to-use 1:1 mix ratio.

DOWSIL™ 121 Structural Glazing Sealant is approved for structural and weatherseal applications, and is used for both in-shop glazing and field repair and replacement.

The sealant features primerless adhesion to glass, alodine, and anodized aluminum as well as adhesion to DOWSIL™ structural sealants for re-glazing applications.

The fast-curing sealant achieves adhesion and structural strength 24 to 48 hours.

DOWSIL™ 121 Sealant meets ASTM specifications C719 and C1184.

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Dow Services

- 40+ year track record in construction
- Technical leadership (R&D, patents, ASTM)
- Authorized distributors
- Laboratory testing for adhesion, compatibility and staining
- Offering 20-year weatherseal, nonstaining and structural adhesion warranties
- Website:
consumer.dow.com/construction



Finally, Dow is truly your partner for sealant specification and testing. We have a 40-plus-year track record in construction, numerous patents, extensive R&D projects, and are involved in all of the industry influencing organizations regarding sealants.

Dow has authored and co-authored numerous ASTM publications, among others. We are fully staffed throughout the country with technical sales people, technical service engineers, and the best distribution network in the industry. We offer all of the laboratory testing discussed in this presentation at no charge for our customers working on construction projects.

Dow offers 20-year limited weatherseal and structural adhesion warranties, and the good news is that they are more than just a piece of paper to us. Dow really stands behind our products.

More information can be found at our website, consumer.dow.com/construction.

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AIA Master Spec

- Individual copies of AIA MasterSpec 079200 and 099653 can be ordered through arcomnet.com or by calling 1 800 424 5080
- We will review your specification for you and offer recommendations at no charge; send specifications directly to our review department at construction@dowcorning.com
- Specs are available on consumer.dow.com/construction

Dow Master Specifications can be obtained through Arcomnet.com.

Specifications can be reviewed by sending an email to construction@dowcorning.com.



This concludes the presentation. Thank you for taking your time to learn about sealants today.

Thank You

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