Making Building Sealants Last

Sealants are critical components of building construction. They must prevent wind and water intrusion into the building envelope around doors and windows while absorbing relative motion between the building components as materials expand and contract due to environmental conditions.

Surveys done in the late 20th century estimated that 55% of sealant installations exhibited failed seals within 10 years, indicating that design and installation practices could be greatly improved.

The sealed joint between a bathtub or shower and its surround is typically a fillet joint (Fig. 1). These sealed joints commonly fail because the sealant is installed without backer rod or bond-breaker. Such installations, where the sealant is pressed all the way into a corner, do not allow the sealant to freely stretch and compress. As a result, the sealant tears away from the substrate with even small relative movements between the tub and surround.

Choosing the Right Sealant

Sealants are used to fill gaps and must be flexible enough to accommodate changes in the gap width as the building moves with changing environmental conditions.

Typically, wider gaps allow for larger movement without exceeding the capabilities of the sealant. Most sealant manufacturers specify a minimum bead size and a proper width to depth ratio for sealant beads. Minimum width and depth are typically 6 mm (0.25 in.) and proper width to depth ratio is typically 2:1. Following these instructions promotes adequate adhesion surface area and proper curing of the sealant.

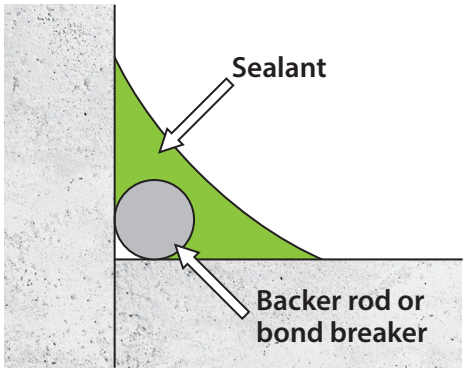

Figure 1. Cross section of fillet joint with properly tooled sealant installed over backer rod to prevent corner adhesion. Without backer rod or bond-breaker tape, the sealant bead cannot accommodate downward motion of the vertical substrate.

Choose a sealant with a manufacturer's movement rating large enough to accommodate the expected joint movement. Sealant movement ratings are typically expressed as percentages of the cured bead width. For example, the highest rating tested in ASTM C719 is +100% and −50%; this means that for a nominal 1/4-in. bead width, the sealant can withstand expansion of 1.0 × 1/4 in. = 1/4 in. and compression of 0.5 × 1/4 in. = 1/8 in.

Proper Installation

Sealant beads react to compression with much higher forces than they react to tension. Compression can be extremely damaging to sealant beads. As the sealant-filled gap shrinks, it tries to squeeze out the sealant. This can break the bond between the sealant and the substrate or even tear the sealant near the bondline. Tension, on the other hand, can rapidly delaminate bonds with poor surface preparation.

Install at the right time

The amount of tension and compression that a sealant bead experiences depends on both the total joint movement and the width of the joint gap at the time the sealant is installed. If sealant is installed when the gap is at its minimum width, the sealant will always be in tension. If the sealant is installed when the gap is at its maximum, the sealant will always see compression. Most installations will experience a mix of tension and compression, but it will not be a balanced mix.

Wood swells and tends to compress joint gaps when it is wet. As wood dries, it shrinks and tends to expand joint gaps. Brick, concrete, and metals expand as temperature increases and contract as temperature decreases. Thus, most joint gaps widen when it gets cold and shrink when it gets warm.

Avoid installing sealant when it is very dry (wood) or very cold (masonry or metal) to prevent putting the sealant in mostly compression. If sealants must be installed under these conditions, make sure gaps are large enough and use sealant rated for high compression to handle this extreme service.

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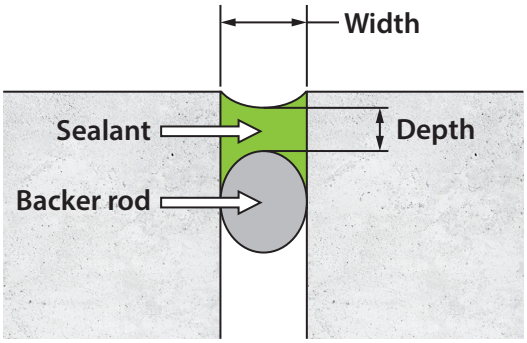

Figure 2. Cross section of butt joint with properly tooled sealant installed over backer rod with recommended width-to-depth ratio of 2:1.

Use round backer rod

Backer rod accomplishes three goals:

1. Backer rod limits bead depth and ensures a 2:1 width-to-depth ratio.
2. Backer rod ensures that the back side of the bead has the preferred concave shape, producing an hourglass cross section for the bead.
3. Backer rod prevents bonding of the sealant on the back side. Back side adhesion in a butt joint (Fig. 2) or corner adhesion in a fillet joint does not allow the sealant bead to stretch freely and can lead to failure.

Use the correct size backer rod

Typically, backer rod should have a diameter slightly larger than the gap width during installation so that it fits snugly in the joint. Consult the backer rod manufacturer's recommendations for the proper size. Choose backer rod sized for the width of the joint at the time of sealant installation. The gap may be larger or smaller than the nominal gap width because of joint movement.

Tool the surface

The exposed surface of the sealant bead should be tooled into a concave shape. That, along with the concave back created by the backer rod, gives the sealant bead an hourglass shape that significantly decreases loads on the bondline when the sealant moves, especially when the bead is compressed.

Always ensure that installation is in accordance with the manufacturer's instructions and consult an architect, structural engineer, or ASTM C1472 for required sealant movement rating. Manufacturers typically specify the temperature range in which sealants may be applied and also how adhesion surfaces must be cleaned and prepared. Some sealant–substrate combinations require use of an adhesive primer.

Test the Product

ASTM recommends that the sealant be applied to a test joint, cured, and then tested for proper adhesion after soaking the joint in water for several hours.

Additional Information

ASTM. 2014. ASTM C719–14, Standard test method for adhesion and cohesion of elastomeric joint sealants under cyclic movement (Hockman cycle). West Conshohocken, PA: ASTM International.

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