Sealants and Exterior Walls

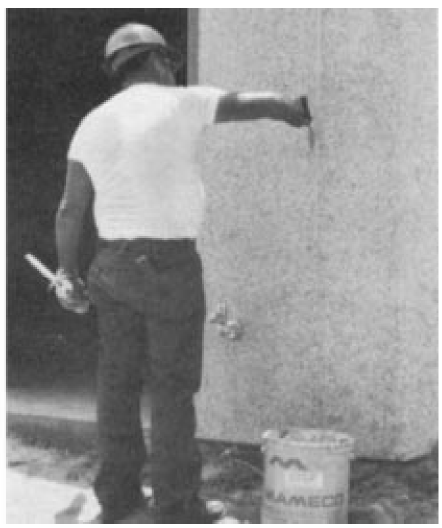
Building a Wall That Won't Leak Involves Using Elements Which Function Well Together

By William H. Harrell
Coastal Construction Products, Inc., Jacksonville, FL

Building walls leak when water comes in an opening that was not adequately sealed. We all know that and the solution: Select wall elements which use products that function together to produce a durable water tight exterior.

If the wall components fail to work together and the building leaks, history suggests that the leak will occur in the President's office, in the computer room or at the building entrance.

If you were the lucky contractor who was awarded the job last year, you are one whose phone will now ring and whose bank balance will begin to decline. How can you best protect yourself from that second phone call?



The applicator is shown putting sealant into the joint (left) and then tooling it off (right)

Here sealant is being applied on the perimeter from a tube vs. bulk application.

Power mixing of a 2-component sealant is efficient and assures a good mix.

While insulated wall panel systems are not new, they are certainly in a rapid state of development. These improvements often bring unexpected problems. One problem is the uncertain performance of these wall systems with the traditional elastomeric sealants—the readily available polyurethane, polysulfide, and silicone products. If these wall components function properly as a system, they keep the water out and the goodwill in. If the wall system fails, the water comes in and goodwill goes out.

The design professionals' emphasis on energy conservation, plus the insistence on better and cheaper ways of constructing or renovating existing structures has produced an increasingly frequent use of lightweight, exterior insulated wall systems. Like any exterior system, these must include some form of elastomeric joint sealant to achieve watertightness.

The sealant must adhere to all products used in the wall system—wall panels, door and window frames, louvers, etc. It must likewise be sufficiently elastic and adhered to permit both the normal expansion/contraction of the building components and retention of a watertight seal while accommodating this movement.

Joint dimensions are shown on architectural drawings as nice straight lines. In reality, the sealant, which is one of the last exterior building components to be installed, must fill whatever hole exists after the inevitable construction tolerances occur. This high performance sealant mate-

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rial is also expected to be inexpensive.

It is this conflict between the quality of performance and the low bid syndrome which creates so many avoidable problems. A functional wall system with appropriate products that properly installed in a well designed building is not necessarily expensive.

As new panel manufacturers come into the marketplace and both new and existing manufacturing create "new improved" versions of exterior finish wall systems, the necessity of pretesting sealant adhesion under realistic job construction conditions becomes critical. Two examples, both of which fortunately involved pretesting and regular inspections, clearly illustrates the importance of an ounce of prevention.

In the first case, several sealants were pretested against panel samples for adhesion with and without primers. The involvement of two subcontractors (one for the panel joints, and the other for the glazing system) resulted in some of the selected sealant being installed with the recommended primer and some with the primer not utilized. The pretesting indicated that the adhesion of the sealant was significantly improved by use of the primer. It also indicated that a soaked panel would result in a cohesive failure within the panel material itself long before a sealant adhesive failure would take place, even without a primer. The availability of this pre-construction test information resulted in an informed, reasonable resolution to what could have been a costly and controversial issue.

In the second situation, many panels had absorbed a large amount of water due to jobsite storage conditions. The panels had been stored horizontally at the jobsite prior to installation. They were inadequately protected and thus had absorbed excess water from pounding rain.

After erection, this moisture drained to the lower part of the panel where it was contained by the exterior coating. Unaware of the entrapped moisture, the sealant contractor applied the recommended primer. The coating system partially dissolved because of the chemical reaction between the primer solvent and the saturated exterior coating. The pre-construction testing of the primer performance (no adverse solvent reaction on the dry panels) immediately identified the source of the problem. This produced a simple solution. Temporary weep holes were made at the panel bottom, allowing the water to drain and the primer to be used as desired.

Having reviewed some sealant-panel issues, the second topic of interest will be to review the sealant characteristics and test standards.

Various sealant data sheets show test results indicating 500-1500 percent maximum elongation tolerances before failure. With such large movement capability, one might feel safe in using a sealant in a ¼" wide joint which is expected to move only an additional ¼". Right?

WRONG!

These elongations are misleading because data sheets don't reveal the nature of the shape of the sealant when tested. Imagine stretching a thin innertube, then stretching 20 of those same innertubes laminated together.

Characteristics and Test Criteria Comparisons of Popular Sealant Standards

1. Standard Published by	Federal	Federal	Federal	ASTM
2. Normal generic base of sealant	Polyurethane or Polysulfide or Silicone	Polyurethane or Polysulfide	Silicone Only	All
3. Number of components of sealant mix	One	Two (or more)	One	Type S = One Type M = Two (or more)
4. Standard reference number	TT-S-230(c)	TT-S-227(e)	TT-S-1543	ASTM C-920-79
5. (a) Self leveling/pourable consistency	Type I	Type I	N/A	Grade P
(b) Non-sag consistency	Type II	Type II	(Non-sag Only)	Grade NS
6. (a) Tested to movement of 50% (± 25%)	Class A	Class A	Class A	Class 25
(b) Tested to movement of 50% (± 12½%)	Class B	Class B	Class B	Class 12½
7. (a) Use classification: T	N/A	N/A	N/A	Traffic joint
(b) Use classification: NT	N/A	N/A	N/A	Non-traffic joint
(c) Use classification: M	N/A	N/A	N/A	Bonding to masonry
(d) Use classification: G	N/A	N/A	N/A	Bonding to glass
(e) Use classification: A	N/A	N/A	N/A	Bonding to aluminum
(f) Use classification: O	N/A	N/A	N/A	Bonding to other surfaces
8. Hardness of cured sealant (Shore A2 O)				
(a) Normal range:	15-50	15-50	15-50	25-50
(b) Except for traffic joints, limited to:	35-50	35-50	N/A	N/A
(c) Hardness after heat aging:	N/A	50-60	N/A	N/A
9. Accelerated weathering test	N/A	N/A	N/A	(ASTM C-793)

It obviously will take a great deal more force to stretch the laminated group any given distance. Perhaps the laminated group could be stretched the 500-1500 percent, but it would take some real engineering to glue the

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outside edges adequately to withstand that much force, without suffering adhesive failure.

Sealants are normally warranted for only 25 percent joint elongation, based on the sealant shapes that arc installed in a typical building. When evaluating sealants, you must consider the shape being stretched, the force required to provide the necessary movement of that shape, and the adhesive limitations of that shape on the tested building element.

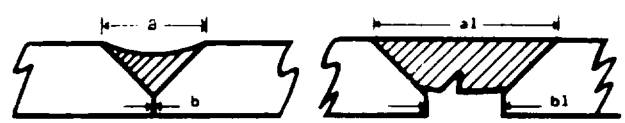
A third topic of interest involves the other surfaces to which the building sealants must bond. These surfaces include a variety of other wall component finishes, such as aluminum, (which may be mill finish, anodized, or flurocarbon coated) or concrete (which may be rubbed, slightly contaminated with form oil residue or even morning dew). The sealant which may be best for anodized aluminum may be totally unsuited for flurocarbon coated aluminum and even a third type of sealant may be best for the insulated wall panel finish. Thus the sealant choice may already be a compromise decision.

Designers and purchasers naturally want competitively equal products to bid against each other. The bonding performance of supposedly equal sealants on various building components (which will likely differ from those components used in standardized tests) frequently will not duplicate their relative merits of being "equal." Many well-intentioned people have discovered this the hard way.

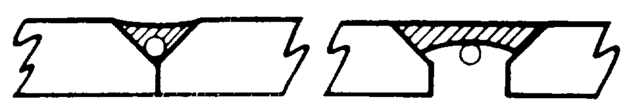
There are three main types of sealant related failures:

1. **Adhesive—the sealant bond strength is exceeded by the movement forces, causing the sealant to pull loose at the bonding interface.**
2. **Sealant Cohesive—the tensile strength of the sealant is exceeded by the movement forces, causing the sealant to tear apart internally.**
3. **Substitute Cohesive—the tensile strength of the building substrate, to which the sealant has been bonded, is exceeded by the movement forces; this substrate tensile strength is less than the adhesive and cohesive sealant strength, causing the substrate to tear apart.**

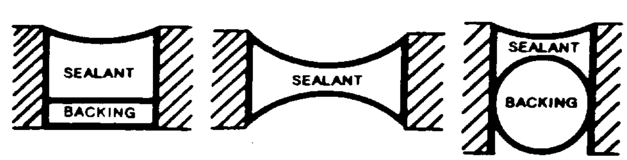
The tensile strength depends upon the sealant type and joint depth. The adhesive strength is a function of the



In a seam to be filled with sealant, the idea is to get both sides adhering—but not at the bottom so the sealant under movement tension may stretch into an arch shape. In this illustration, the drawing at left shows that the bottom of the sealant is bonded so when there is movement a split occurs as in the illustration at the right.



For "V" joint sealing, a filler strip should be inserted in such a way that minimum opening at the bottom is not filled with sealant, thus the sealant can stretch arch-shaped as at the right.

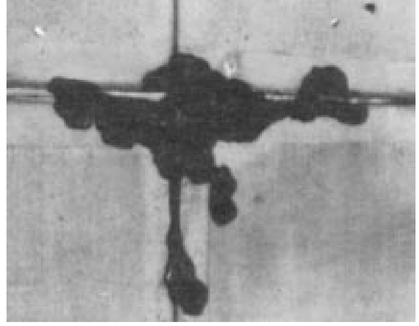


The ideal stretched configuration is shown in the middle drawing where both top and bottom show arches. The proper backing material (left) together with proper tooling will provide for a good joint, as will the approach shown at the right.

surface area of sealant in proper contact with the substrate. Since it is a certainty that building movement is going to occur, it is a certainty that movement forces will be provided. Engineering formulas not withstanding, the building will not likely move as it is expected to move.

If two joints each expand ¼" and if one of these joints was originally only ¼" wide, it will have stretched 100 percent (and perhaps failed) while a similar movement in the other joint, if it was originally 1" wide, will have stretched only 50 percent (and likely remained intact). Thus wider joints are normally better. But who, besides sealant suppliers, likes to see wide joints? Narrow joints are less conspicuous-but should be recognized as more likely to fail when stretched a given distance.

This overview of some of the complexities involved in having a quality sealant properly installed by a qualified applicator in an adequately designed joint may frighten one into thinking there are no answers to this



This is a good illustration of a seam where the sealant quality is absent, and the sealant simply oozes out. This isn't rubber; it's goo.

impossible problem. To the contrary, it is safe to assume that there is indeed an answer to these conflicts.

Responsible manufacturers of sealants will pretest, at no charge, the adhesion of their sealants to samples of the building components to determine which of their sealants and primers, if any, are best for a particular exterior wall system. It is very difficult, without testing, to give an answer to the question of which sealant type, or even which manufacturer of that type of sealant, is best because so many variables are involved. Instead, there probably will be a specific answer for a specific building. Take advantage of a distributor or manufacturer having several sealants, so that pre-construction sealant tests can be run thereby identifying the best sealant product. Then research the qualifications of the sealant applicator, not only the company but also the experience of the foreman assigned to the job. In a marketplace as competitive as that of sealants, significant price difference between "equal" products should be viewed with caution. The two products may meet the same minimum standard specification, but will not necessarily perform equally in the particular job conditions.

In summary, select sealants after evaluations know performances and test results, to be supplied by firms who have demonstrated a sustained successful presence in the marketplace and which will be installed by experienced applicators. Consider the wisdom of letting your competitor save a buck and experiment on his own. Your bank balance will soon surpass his.