CONCRETE Joint and Crack Sealing Basics

BACKGROUND

Proper joint sealing contributes to good performance on roadways and airports. With proper design and construction, joint sealants minimize infiltration of surface water and incompressible material into the joint system.

While many agencies specify single-component cold-pour (silicone) sealants, there are no standard national specifications for these materials. Each agency must either use the manufacturer's recommendations or develop its own specification. Sealant properties necessary for long-term performance depend on the specific application and the climatic environment of the installation. **Flex Crete™ is one product that can be used for all joint and crack sealing and resealing projects and is compatible with all concrete and asphalt pavements.**

Properties to consider include:

• Elasticity: The ability of a sealant to return to its original size when stretched or compressed.
• Modulus: The change in internal stresses in a sealant while being stretched and compressed over a range of temperatures (stiffness of material). A low modulus is desirable and is particularly important in cold weather climates.
• Adhesion: The ability of a sealant to adhere to concrete. Initial adhesion and long-term adhesion are equally important.
• Cohesion: Ability of a sealant to resist tearing from tensile stresses.
• Compatibility: Relative reaction of the sealant to materials which it contacts (such as backer rods and other sealants).
• Weatherability: Ability of a sealant to resist deterioration when exposed to the elements (primarily ultra violet sun rays and ozone).

SHAPE FACTOR

The shape factor is the ratio of depth to width of a field poured liquid sealant. The saw cut width and insertion depth of the backer rod define the sealant shape. The shape factor is critical to long-term success of liquid sealants. The cross section of a joint sealant changes during the expansion and contraction of the concrete pavement. The movement induces strains within the sealant and stress along the sealant/reservoir bond line. These material responses become excessive if the shape factor is not appropriate for the sealant material.

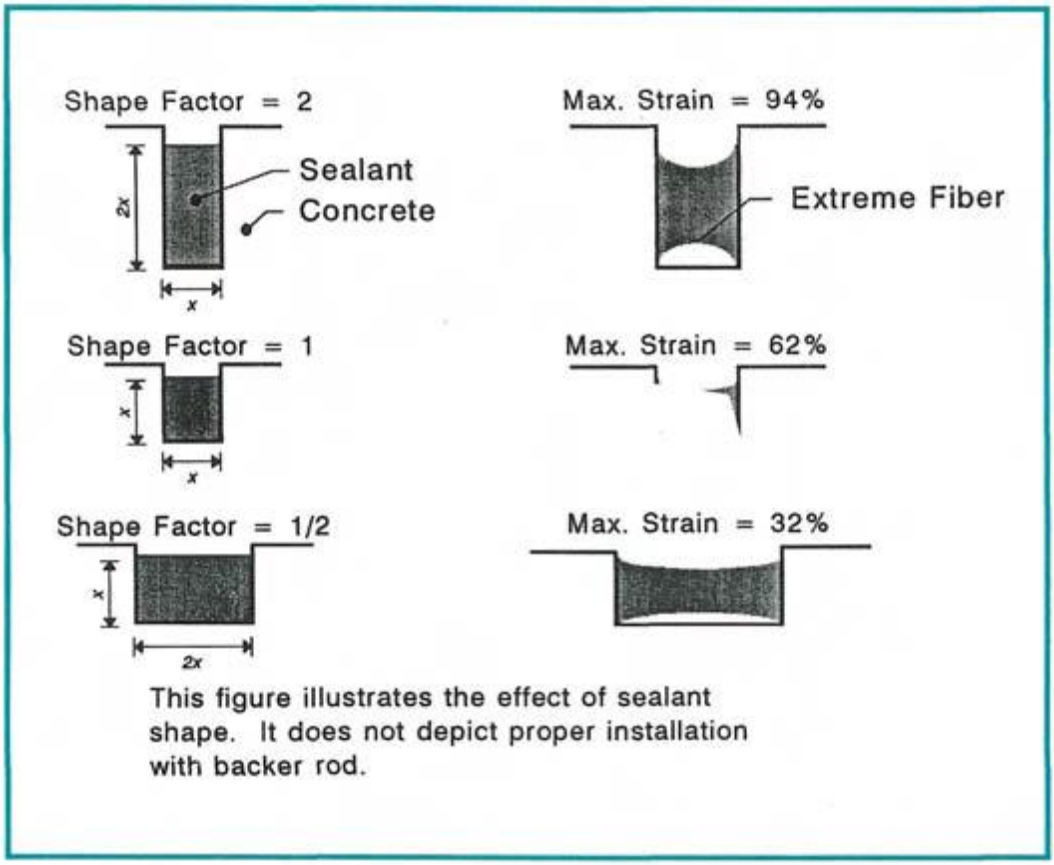


Figure 1 Strain on the extreme sealant fiber for different shape factors.

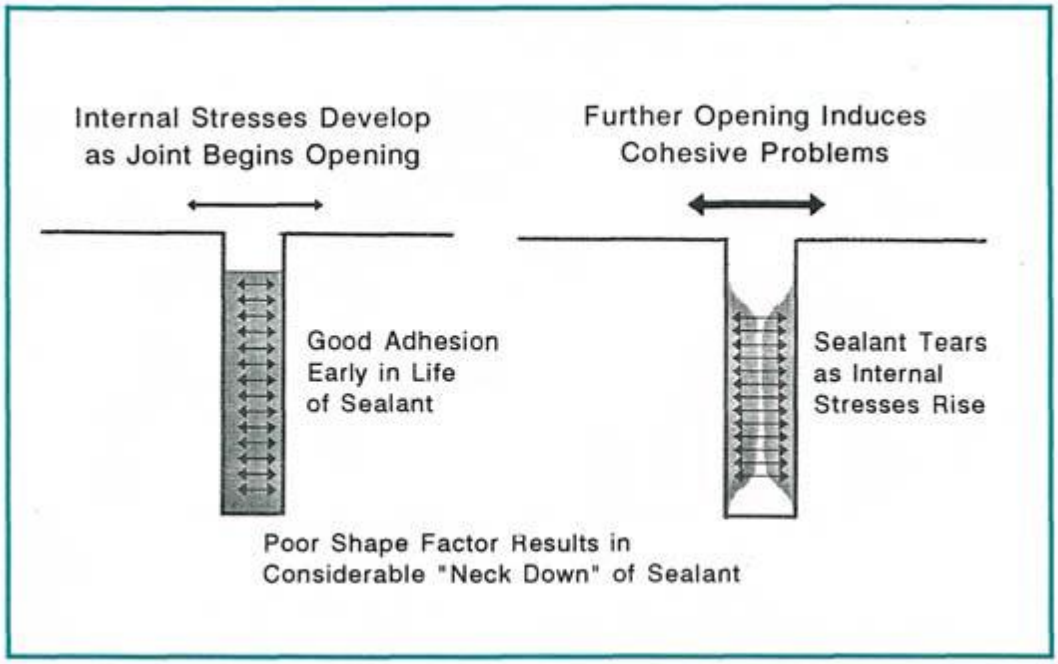
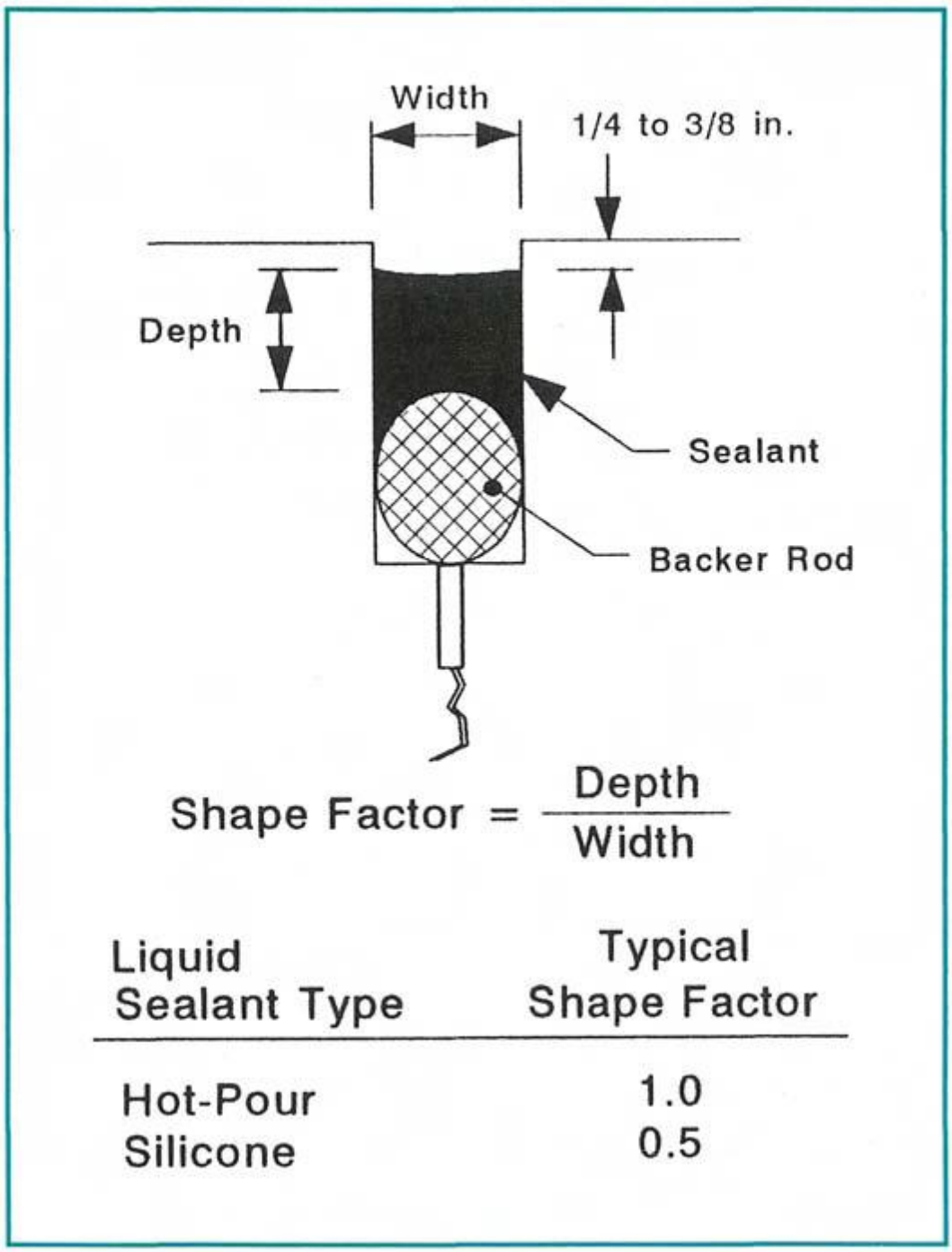


Figure 2 A large shape factor induces high internal tensile stresses from joint opening and results in cohesion loss. (Also note no backer rod - poor practice).

Cohesion loss is not unusual in narrow and deep joints. Many agencies provide a single reservoir cut to 1/3 or 1/4 the slab depth. The agency specifies pouring a sealant directly into the saw cut. The single cut is difficult to clean and the shape factor (ratio of depth to width) can approach 25. Cohesion loss is not unusual in these situations. At early ages, tensile stresses from joint opening may overcome cohesion in an improperly shaped sealant before overcoming the bond. (Figure 2)



Liquid Sealant Type	Typical Shape Factor
Hot-Pour	1.0
Silicone	0.5

Figure 3 Typical shape factors for liquid sealants. **Flex Crete™ can have a Shape Factor of up to 1.5 on reservoirs up to 2" (50.8 mm) wide and significantly higher on reservoirs less than 1" (25.4 mm) wide.**

Use of backer rod is important and acts as a bond breaker to prevent adhesion to the reservoir bottom. The stresses within the sealant material increase if bond develops along the base of the sealant. Adhesion loss results because the sealant is constrained from neck down at the reservoir bottom during joint opening.

SEALING AND RESEALING APPLICATION STEPS

1. Old sealant removal - **RESEAL**
2. Shaping the reservoir - **RESEAL**
3. Cleaning the reservoir
4. Installing the backer rod
5. Installing the sealant

Old Sealant Removal — Adhesion will not develop by simply filling over an existing sealant. Removal of the old sealant and joint face cleaning are essential. These processes provide a surface to which a new sealant can bond. It is imperative that methods for removing old sealant do not damage the joint reservoir. The following provide acceptable results:

- Manual Removal: Typically, manual removal is easy for compression seals. This simple method provides a quick result whenever feasible and does not leave much material on the reservoir sidewalls.
- Sawing: The most common removal and efficient method is sawing with diamond blades. It is efficient because sawing also shapes the reservoir for the new material.
- Plowing: Plowing can be very effective for removing most of the old sealant. A small plow pulled through the reservoir dislodges the material. Operators must be careful in selecting the plow design. Avoid vee-shaped plows. Very little damage occurs with a rectangular plow.

Shaping the Reservoir — Sawing/widening shapes the reservoir after sealant removal. Saws with dry or wet diamond blades are acceptable. The blades remove any remaining old sealant and provide the proper dimensions for the new sealant. In certain instances eliminating this step may be acceptable. Shaping is unnecessary if sealant removal was by hand and the existing reservoir provides adequate dimensions. Sawing out the old sealant typically provides an adequate reservoir and should not require this step either.

Cleaning the reservoir – Cleaning is the most important aspect of joint sealing. For every liquid sealant, manufacturers require essentially the same cleaning procedures. Likewise the performance claims of any liquid sealant product are predicated on those cleaning procedures. Reservoir faces require a thorough cleaning to be sure of good sealant adhesion and long-term performance. No dust, dirt or visible traces of old sealant should remain on the joint faces after cleaning. The ability to attain this condition may depend on the reservoir width. Most contractors report that it is easier to consistently get joints clean if they are at least 3/8 in (9 mm) wide. Cleaning 1/8 in (3 mm) or even 1/4 in (6 mm) is very difficult.

Do not use chemical solvents to wash the joint reservoir. Solvents can carry contaminants into pores and surface voids on the reservoir faces. Contaminants will inhibit bonding of the new sealant. Proper

cleaning requires mechanical action and pure water flushing to remove contaminants. The following outlines the recommended procedures (Steps a) and b) refer to RESEALS):

a) Immediately after sawing, a water wash removes the slurry from the sawing operation.
b) After the joint has sufficiently dried, a sandblasting operation removes any remaining residue.
c) An air blowing operation removes sand, dirt and dust from the joint and pavement surface. Conducting this operation just prior to sealant pumping ensures that the material will enter an extremely clean reservoir.

Backer Rod Installation — Backer rod installation is made after cleaning and before liquid sealant installation. It must be compatible with the liquid sealant with a diameter about 25 percent greater than the reservoir width. Backer rod inserts easily with a double-wheeled, steel roller or any smooth blunt tool that will force it uniformly to the desired depth. Ensuring that the backer rod is at the proper depth cannot be over emphasized.

Sealant Installation — Installation requirements are slightly different for each sealant type. Manufacturers recommend some curing time before opening to traffic for most liquid sealants. Some liquid seal manufacturers also specify limits on the ambient and pavement temperatures for installation. Liquid sealants require uniform installation. **Unlike other liquid sealants, over-filling or completely filling the reservoir is desirable with Flex Crete™ which will leave the desired sealant recess of least 1/4 - 3/8 in. (6-10 mm) below the surface of the pavement. Filling the reservoir from the bottom upward avoids trapping air pockets. It is important that the contractor pumps the sealant through a nozzle sized for the width of the joint reservoir. The nozzle should fit into the reservoir to allow pumping to the bottom.** The injection nozzle forms the sealant bead. Good practice is to draw the nozzle toward the operator. Pushing the nozzle may result in voids and non-uniform sealant cross-section.

Tooling of joints – Tooling of sealants is the use of an object to smooth and move the sealant into a position advantageous to both an acceptable appearance as well as a watertight seal capable of enduring years of environmentally induced movement and degradation. The primary functional purpose of this process is to make the sealant as intimate as possible – with the substrate being sealed providing the best possible chance for proper adhesion. Sealant manufacturers may not require tooling but it certainly could mean the difference between a professional, long-lasting, aesthetically-pleasing piece of work or a callback. It's definitely worthy of discussion. The basics are to tool the sealant concave with constant pressure to ensure adequate contact of the sealant with the surface to be sealed. The concave configuration is recommended to allow for a flush surface when the sealant is compressed, and also to create the infamous "hour glass" configuration that provides for the greatest movement capability. The inner concavity is provided by cylindrical backer rod and the outer concavity results from a rounded edge spatula utilized in the tooling process. **Flex Crete™ does not require tooling but if tooling is desired, a natural outer concavity is achieved through the natural curing process of the sealant. As mentioned, Flex Crete™ should be filled flush with the pavement surface.** Taping of joints is another part of the tooling process which aids in that unending drive for perfection. The rule here is to always remove the tape before the sealant begins to skin or cure – or in other words, while

the sealant is still wet. Do not apply excessive amounts of sealant as this will make removal of the tape an art in and of itself in attempting to avoid webs of sealant from attaching themselves to you and the pavement surfaces.

SPECIAL CONSIDERATIONS FOR CRACKS

Like joints, some cracks also require sealing to prevent moisture and incompressible infiltration. The orientation and type of crack dictates sealing necessity. Cracks which remain tight usually do not require sealing. These cracks are typically very narrow (hairline) cracks.

Cracks are not straight and are therefore more difficult to shape and seal. Avoid trying to follow crack wander with a standard blade. Manufacturers provide special crack-sawing blades to help the operators follow crack "wander". The special blades with diameter from 7 - 8 in (18 - 21 cm) are also more flexible to aid in crack tracing. Even with special blades, a sawed crack reservoir will not be as uniform or clean as a straight joint reservoir.

After repair and sawing, crack sealing requires all of the cleaning steps used in joint sealing. That includes the use of a backer rod and uniform sealant installation. **Flex Crete™ does not require the use of saw cutting or backer rod installation on cracks. However it is imperative that the crack reservoir is filled from the bottom up and is completely full of sealant to avoid air pockets and cohesion loss. The use of a rubber V or U shaped squeegee will help ensure the complete filling of the reservoir and promote better adhesion.**