Seal No Seal GROUP

Tech Brief

Concrete Pavement Compression Seals

Introduction

Compression seals were introduced in the early 1960s. They differ from liquid sealants because they are manufactured ready for installation and do not require field heating, mixing, or curing.

Polychloroprene (Neoprene) is the principal compound in compression seals. It is a synthetic rubber that provides excellent rebound pressure under compression. It is highly resistant to compression set, ozone, aging, sunlight and weathering, abrasion, gouging, oil, chemicals, rubber removal, and temperature extremes.

Compression seals contain a series of internal webs. The webs provide the outward force which holds the sealant against the joint walls.

The development of preformed compression joint seals resulted from the belief that an unsealed, jointed pavement had a built-in potential to destroy itself early in its design life[1].

At the time, wide variability in pavement jointing design and forming practices, climatic behavior, materials, and construction methodologies drove the need for a versatile and long-life pavement joint seal.[1]

Original Design Criteria for Pavement Compression Seals

To develop an effective concrete pavement compression seal, the following design criteria were considered: [1]:

- Movement capability consistent with volume and temperature changes for a specific pavement design and environment.
- Seal out the entry of water and, if possible, channel it off the pavement as quickly as possible.
- Seal out the entry of incompressibles from the top **and sides of the pavement**.
- It must exert a compressive force against and maintain contact with the joint walls during extremes of slab movement.
- It must absorb the expansion movement within itself without being extruded above or expelled from the joint opening.
- It must be rugged enough under any condition of slab movement to withstand forces inherent to repetitive traffic loadings and **the downward forces exerted through snow, slush, maintenance materials, and incompressibles**.
- It must be capable of performance in extremes of hot and cold weather.
- Because of the difficulty of getting joints "surgery room clean" in the field, its performance should not be entirely dependent on the ability to maintain a bond to concrete.
- It must have an extended outdoor service capability and be relatively unaffected by sunlight, ozone, petroleum products, chlorides, soil bacteria, maintenance chemicals, cement alkalis, extremes of hot and cold temperatures, forces of abrasion, and compressive strains of long-term duration.

Development of the Compression Seal Configuration

Early on, experiments were conducted with different internal web configurations to obtain the maximum residual compressive forces against the joint faces under all stages of joint movement. These experiments resulted in a general standardization of the cross-braced webs shown on the left-hand side of Figure 1. The right-hand side of Figure 1 indicates a modern-day DS Brown six-cell configuration. The six-cell design appeared as an improvement in the mid-1990s and remains the best design to this day.

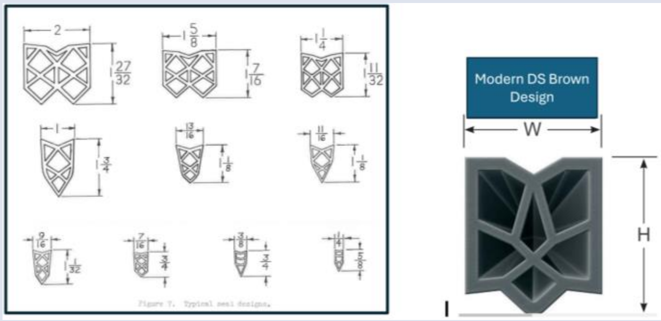

Figure 1 Compression Seal Shapes[1,2]

Lubricant/Adhesive

From the beginning, it was recognized that it would be difficult, if not impossible, to insert a typical compression seal into a groove without some type of lubricant.

Some of the earliest installations were made with oil soap. Eventually, many lubricants/adhesives, both emulsions and solvent-based, were experimented with, but a neoprene-based adhesive was ultimately selected. Adding the adhesive provides additional bonding to and filling the surface irregularities on the joint face.

Some of the early thoughts on the need for lubricants/adhesives were as follows:

- A priming agent is mandatory to seal a joint with compression seals so that it is completely leakproof. Any existing capillary system in the surface of concrete, porosity, minor spalls, and cavitation inherent to joint sawing and the blasting effects of sawing slush must be repaired with a durable material.
- The ability to bond to concrete is related to the ability to properly clean and maintain the cleanliness of joints before installation.

Compression Seal Selection

Compression seal selection begins by choosing a design that conservatively accommodates the expected joint movement over its life span.

Since compression seals have service lives as long as 30 years, the range in temperatures over the entire life span should be considered.

The American Concrete Pavement Association (ACPA) has an online tool for estimating joint movement for specific local conditions: http://apps.acpa.org/applibrary/JointMovement/.

Once the estimated movement is known, the sealant manufacturer's literature can be consulted for the required compression seal type, dimensions, and reservoir size. It is critical that the seal sizing and reservoir design are compatible with the manufacturer's recommendations. As stated previously, compression seals are only successful when they exert sufficient lateral pressure on the joint's walls; reservoir sizing is critical. Good performance results when seals remain compressed between 20 and 50 percent at all pavement temperatures.

Figure 2 below indicates a typical table found in the manufacturer's literature.

Delastic® Seal Catalog No.	Seal Characteristics			Joint Installation Criteria		Total Joint Movement	
	Nominal Width	Nominal Height	Max. Movement	Minimum Depth	Typical Installed Width**	Narrowest Opening	Widest Opening
E-437	0.437 (11.11)	0.937 (23.81)	0.153 (3.88)	1.000 (25.40)	0.250 (6.35)	0.219 (5.56)	0.372 (9.45)
E-562	0.562 (14.29)	0.625 (15.88)	0.188 (4.78)	1.063 (27.00)	0.3125 (7.94)	0.290 (7.37)	0.478 (12.14)
E-686	0.687 (17.46)	0.687 (17.46)	0.259 (6.59)	1.188 (30.18)	0.375 (9.53)	0.325 (8.26)	0.584 (14.84)
E-816	0.812 (20.64)	0.830 (21.08)	0.313 (7.95)	1.438 (36.53)	0.500 (12.70)	0.378 (9.59)	0.691 (17.54)
E-1006	1.000 (25.40)	1.000 (25.40)	0.450 (11.43)	1.625 (41.28)	0.5625 (14.29)	0.400 (10.16)	0.850 (21.59)
E-1256	1.250 (31.75)	1.000 (25.40)	0.563 (14.30)	1.875 (47.63)	0.750 (19.05)	0.500 (12.69)	1.063 (26.99)
V-1625	1.625 (41.28)	1.125 (28.58)	0.631 (16.03)	2.250 (57.15)	0.875 (22.23)	0.750 (19.05)	1.381 (35.08)
E-2000	2.000 (50.80)	1.500 (38.10)	0.950 (24.13)	2.500 (63.50)	1.125 (28.58)	0.750 (19.05)	1.700 (43.18)
E-2500	2.500 (63.50)	2.500 (63.50)	1.125 (28.58)	3.375 (85.73)	1.375 (34.93)	1.000 (25.40)	2.125 (53.98)
E-3000	3.000 (76.20)	2.500 (63.50)	1.550 (39.37)	4.000 (101.60)	1.750 (44.45)	1.000 (25.40)	2.550 (64.77)

Figure 2 Example of Manufacturer's Information[2]

Reservoir Preparation

Once the reservoir has been sawn to the proper dimensions, it should be media blasted to provide a clean, bondable surface. Although compression seals rely mainly on lateral compressive forces, the adhesive provides additional benefits when bonding to clean joint faces.

Unlike liquid sealants, compression seals exploit the bottom edges of the reservoir to provide support from being pushed further down into the joint due to vertical forces incurred from ice formation, incompressibility, etc., as traffic passes over the joint.

Compression Seal Installation

Compression seals are installed using a mechanical device that places the lubricant/adhesive on the seal and installs it at the proper depth. Figure 3 shows an example of the installation equipment.

Figure 3 Joint Sealant Installation Equipment

Figure 4 provides an example of a well-installed compression seal. The proper installation is to install the longitudinal seal first. After allowing the glue to dry (approximately 20 minutes), the longitudinal seal is cut with a sharp instrument or saw blade at the middle of the intersection of the transverse joint. The material should retract, leaving enough room for the transverse sealant. The transverse joint seal is then installed through the cut in the longitudinal seal to form a tight intersection. The transverse seal should be installed in one continuous piece.

For lane additions or staged construction, placing seals continuously in the transverse joint is not always possible. In these situations, the transverse seals should be cut such that when the longitudinal seal is placed, the seal forms a tight seal against the longitudinal seal.

When installing seals, it is essential to minimize the stretch of the compression seal to less than four percent. This ensures the continuous outward pressure required for the seal to perform over the expected sealant life.

Figure 5 indicates the end view of an installed compression seal. Note the lubricant/adhesive and the support from the bottom of the reservoir cut.

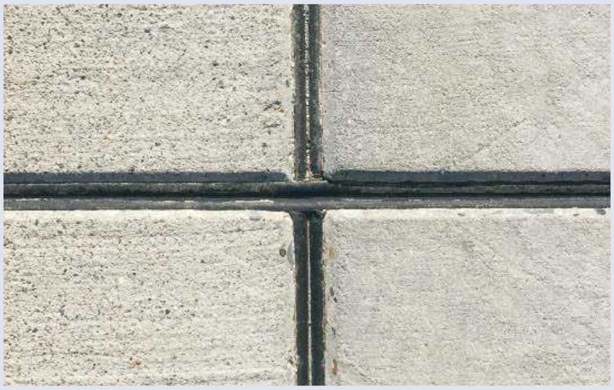

Figure 4 Photo of Properly Installed Compression Seal[2]

Figure 5 Compression Seal Installed[3]

Benefits of Compression Seals

Compression seals are known for their long service life. This is why AASHTO's PaveME pavement design software indicates that compression seals are the only sealants that extend pavement performance.

Since compression seals exert pressure against the joint reservoir walls, fewer sliver spalls appear over time than with liquid sealants which create constant tension on the walls.

References

1. Watson, Stewart, "Performance of Compression Seals", Highway Research Record No.80, 1965
2. Delastic® Preformed Pavement Seals, www.dsbrown.com
3. Concrete Pavement Joint Sealing/Filling, ACPA Technical Bulletin TB010-2018, TB010-2018 Wikipave.org