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EPOXY & FIBERGLASS FLOORING, SEAMLESS FIBERGLASS WALL SYSTEMS, SEALERS, HIGH PERFORMANCE COATING SYSTEMS, AND INDUSTRIAL CLEANERS

JOINT PULL APART

At this point we have done perhaps 400 miles of joint filler and have seen any number of circumstances with our materials and those of others. Among the most common are joint materials that pull away from the side walls of the joint. In the majority of cases this is due to the concrete shrinkage that continues for perhaps a year after the joint has been filled.

Below, courtesy of a competitor, Euclid Chemical Company, and the ACI – American Concrete Institute- are write ups on this as a common place and to be expected occurrence. For brevity I will comment and use these as more in depth references for your review below.

Also, lastly is a durometer comparison scale. There are three scales OO, A and D. Joint fillers have hardness ratings in either A or D. It is useful to have a comparison scale to translate one to another. For instance a durometer of A80= D30.

The write up from Euclid is substantially correct and well done emphasizing that the joint needs to be completely filled for it to last, the wall edges need to be clean, and the over spill needs to be shaved off giving a smooth surface. Beyond that care needs to be taken that the joint filler can withstand the expected chemical exposure and be applied at the operating temperature.

Freezers and coolers need joints filled at their operating temperatures so concrete shrinkage with temperature drop does not cause pull apart at the joint walls. If the unit is expected to be raised and lowered in temperature the best that can be done is filling at the expected mid point in temperature range and hope for the best. For this we use our PFAC I which will cure to -40F. This is also a VERY TOUGH material withstanding 50 ton earth mover steel tracks for 20+ years. See below.

As noted below flexible joint fillers are not as flexible as some might think,- see description of this below- and those “caulks” which are VERY elastic so not give any joint wall protection – they are often used to go over isolation joints to seal them for cleanliness, and even as such we have seen (and repaired) them as they too pulled away from walls, etc., as the concrete continued to shrink. You should note that at lower temperatures this elasticity diminishes as the “caulk” gets colder. Think bubble gum in a freezer.

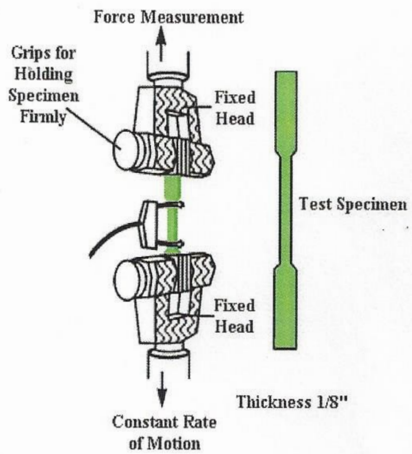
So concrete shrinkage is normal and to be expected for the first year or so some and joint pull apart should also be expected and planned for. Tom Hennessy March 2018

Technical Bulletin Series ECTB 10-10

EUCLID CHEMICAL

Joint Filler Elongation, Separation, and Repair

The ultimate tensile elongation of a material is the percentage increase in length that occurs before the material breaks under tension. The figure below shows a typical tensile elongation specimen and test apparatus. Very rigid materials such as epoxy adhesives often exhibit elongation values under 5%, whereas a flexible polyurethane sealant has an elongation at break of over 300%.

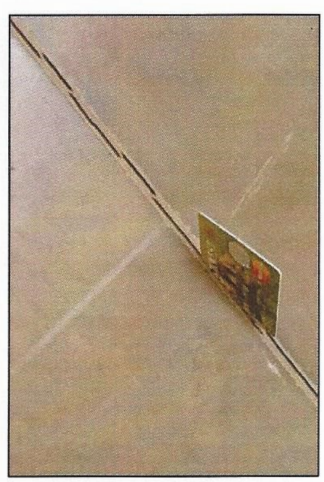


The tensile elongation of semi-rigid joint fillers is a frequently specified property. Many engineers believe that the use of a high elongation filler will allow for early filling of joints in a new floor, and that the filler will "stretch" along with the joint as it opens due to slab shrinkage. This logic is incorrect. The tensile test illustrated at left measures the ability of the joint filler material to stretch along the length of the test specimen, but control joints in concrete floors do not elongate lengthwise, they widen laterally (side-to-side). **The tensile elongation test does not represent actual control joint movement and the ability of the joint filler to move along with it.**

A typical polyurea joint filler with tensile elongation of 300% can expand laterally about 10% before it splits cohesively (within the filler itself) or adhesively (along the joint filler/concrete bond line). Similarly, an epoxy joint filler with 50% elongation will usually tolerate about 5-8% lateral expansion before splitting. Since shrinkage-related joint opening is often greater than what the joint filler can handle, early installation of joint fillers will almost certainly result in splitting or loss of adhesion.

Section 9.10.1 of ACI 302.1R, Concrete Floor and Slab Construction, states:

"Concrete slabs-on-ground continue to shrink for years; most shrinkage takes place within the first 4 years. The most significant shrinkage takes place within the first year, especially the first 60 to 90 days. It is advisable to defer joint filling and sealing as long as possible to minimize the effects of shrinkage-related joint opening on the filler or sealant. This is especially important where semi-rigid fillers are used in traffic-bearing joints; such fillers have minimal extensibility. If the joint should be filled before most of the shrinkage has occurred, separation should be expected between the joint edge and the joint filler or within the joint filler itself. These slight openings can subsequently be filled with a low-viscosity filler recommended by the same manufacturer as the original filler. If construction traffic dictates that joints be filled early, provisions should be made to require that the contractor return at a pre-established date to complete the necessary work using the same manufacturer's products. Earlier filling will result in greater separation and will lead to the need for more substantial correction; this separation does not indicate a failure of the filler."

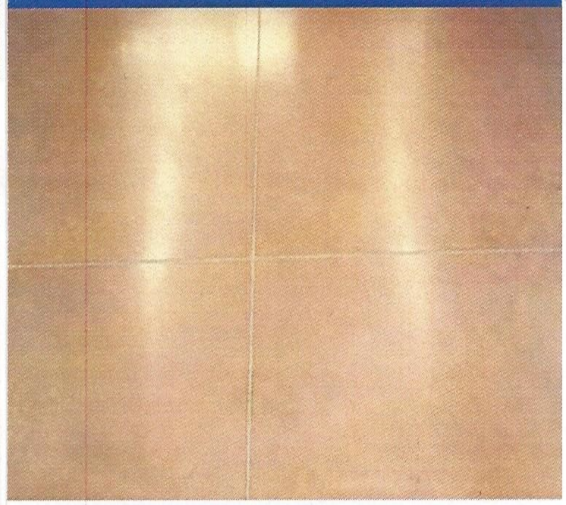


Minor joint filler separation (less than a credit card thickness) does not affect the filler's ability to transfer load and protect joint edges under traffic. However, if cracks in the filler are wide (as seen in the photo at right), or if joint edges show signs of spalling, in facilities where seamless floors and sanitary conditions are critical, or where the separation is aesthetically objectionable, the separation is often repaired at the discretion of the facility manager or owner. There are two methods for correcting joint filler separation voids. The easier option is to clean debris from all voids and fill voids with the same joint filler used initially or a low-viscosity epoxy adhesive. For a more durable repair, saw out the top ½ inch (12 mm) of joint filler with a concrete saw or crack chaser and refill with the same joint filler installed initially.

Industry Standards Regarding Joint Filler Installation Timing and Depth

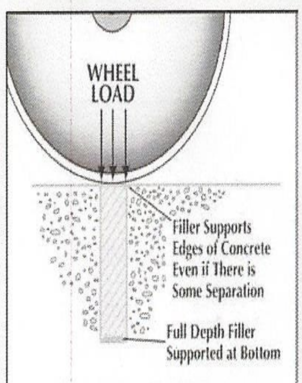
Concrete slabs-on-grade continue to shrink for many years after placement. To reduce the effects of slab shrinkage on the joint filler, The American Concrete Institute (ACI) recommends that joint filling be deferred as long as possible after the concrete slab has been poured. If, due to project scheduling requirements, joints are filled before the greater part of the shrinkage has occured, separation should be expected within the joint filler itself or along the line where the joint edge and filler meet. This separation is not a sign of failure of the QWIKjoint 200.

ACI further recommends that semi-rigid joint fillers like QWIKjoint 200 be installed full depth in saw-cut control and construction joints. Because this particular material sets so quickly, the time-consuming process of sealing any cracks in the bottom of the joint with backer rod or sand is not necessary. However if inert material is used to seal joint bottoms, QWIKjoint 200 must be installed at a minimum depth of one inch (2.54 cm).

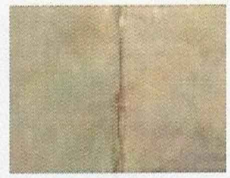


Why Fillers are Important

Joint fillers are necessary because control (contraction) and construction joints are susceptible to damage from impact if they are not filled. Wheels on forklifts and carts cause stress that can break off the edges of unprotected joints, causing deterioration of the joint that will worsen over time. QWIKjoint 200 is durable and resilient, enabling the filled joint to support wheel traffic.



Semi-rigid joint filler in joint not designed for movement – can support wheel loads across joint.



Unfilled joints will spall and deteriorate under heavy wheeled traffic.

concern in doweled joints, where the dowels may restrain the movement of the slab. For this situation, square or rectangular dowels cushioned on the vertical sides by a compressible material are available in dowel basket assemblies and can reduce this restraint (Fig. 5.10 and 5.12).

For slabs that contain steel fibers, the sawcut using the conventional saw should be 1/3 of the slab depth. Typically, experience has shown that, when timely cutting is done with an early-entry saw, the depth can be the same as for unreinforced (plain) concrete for lower fiber concentrations and preferably 1-1/2 ± 1/4 in. (38 ± 6 mm) for higher fiber concentrations up to a 9 in. (230 mm) thick slab. Regardless of the process chosen, sawcutting should be performed before concrete starts to cool, as soon as the concrete surface is firm enough not to permit dislodging or spalling of steel fibers close to the floor surface to be torn or damaged by the blade, and before random drying-shrinkage cracks can form in the concrete slab. Shrinkage stresses start building up in the concrete as it sets and cools. If sawing is unduly delayed, the concrete can crack randomly before it is sawed. Additionally, delays can generate cracks that run off from the saw blade toward the edge of the slab at an obtuse or skewed angle to the sawcut.

5.4—Joint protection

Joints should be protected to ensure their long-term performance. Regardless of the materials chosen for protection, the joint must have adequate load transfer, and the surfaces of adjacent slabs should remain in the same plane.

For wheeled traffic, there are two ways to protect a joint: fill the joint with a material to restore surface continuity, or armor the edges with steel angles or plates. Certain types of semirigid epoxy or polyurea are the only materials known to the committee that can fill joints and provide sufficient shoulder support to the edges of the concrete and prevent joint breakdown. Such joint materials should be 100% solids and have a minimum Shore A hardness of 80 when measured in accordance with ASTM D 2240. Refer to Section 5.5 for more details on joint filling and sealing.

For large slab placements where sawcut contraction joints are not used, and the joint width at the construction joints may open significantly, such as post-tensioned slabs, or slabs cast with shrinkage-compensating concrete, it is recommended that the joints be protected with back-to-back steel angles (Fig. 5.15) or bars, as shown in Fig. 5.14. It is critical that the top surfaces of the angles or bars used to armor be true. Milling may be required to produce a flat surface if conventional rolled shapes or bar stock is used for this purpose. Steel-armored joints less than 3/8 in. (9 mm) in width can be sealed with an elastomeric sealant as described in ACI 504R. Armored joints where width is 3/8 in. (9 mm) or greater should be filled full depth with semirigid epoxy or polyurea joint filler, or with a joint filler with an integral sand extender to provide a smooth transition for wheel traffic.

Construction and sawcut contraction joints that are unstable will not retain any type of joint filler. Joints are unstable if there is horizontal movement due to continued shrinkage or temperature changes, or vertical movement due to inadequate load transfer. Regardless of the integrity of initial construction, the continued movement of a filled, curled, undoweled joint under traffic may prematurely fatigue the filler/concrete interface to failure. Joint edge protection provided by supportive filler is increased when load-transfer provisions are incorporated in the joint design.

5.5—Joint filling and sealing

Where there are wet conditions, hygienic and dust control requirements, and the slab is not subjected to wheel traffic, contraction and construction joints can be filled with joint filler or an elastomeric joint sealant. Joints subjected to wheeled traffic should be treated as discussed in Section 5.4.

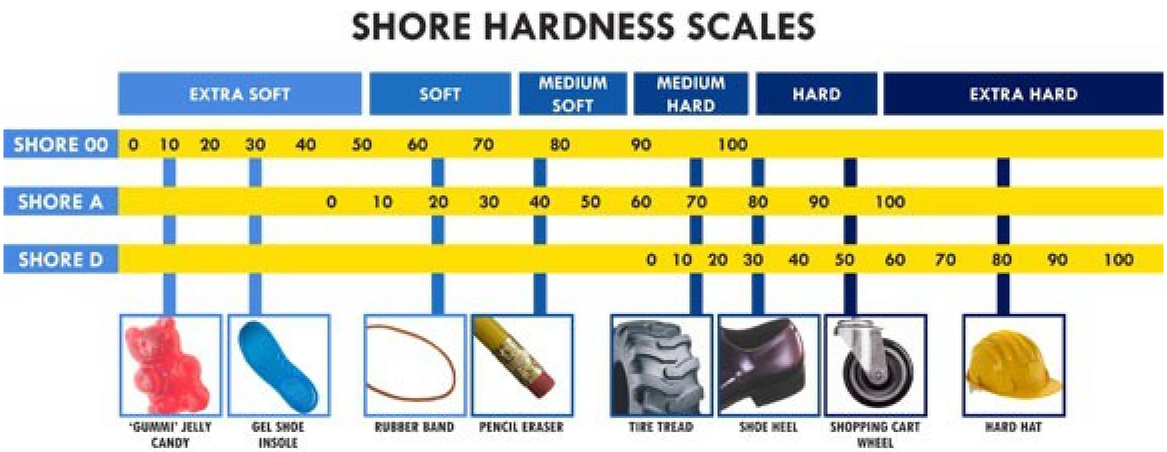
Isolation or other joints are sometimes sealed with an elastomeric sealant to minimize moisture, dirt, or debris accumulation. Elastomeric sealants should not be used in interior joints that will be subjected to vehicular traffic unless protected with steel armored edges. Refer to ACI 504R for more information on elastomeric sealants.

5.5.1 *Time of filling and sealing*—Concrete slabs-on-ground continue to shrink for years; most shrinkage takes place within the first year. It is advisable to defer joint filling and sealing as long as possible to minimize the effects of shrinkage-related joint opening on the filler or sealant. Ideally, if the building is equipped with an HVAC system, it should be run for 2 weeks before joint filling. This is especially important where joint fillers are used in traffic-bearing joints because such materials have minimal extensibility. If the joint should be filled before most of the shrinkage has occurred, separation should be expected between the joint edge and the joint filler, or within the joint filler itself. These slight openings can subsequently be filled with a low-viscosity compatible material. If construction traffic dictates that joints be filled early, provisions should be made to require that the contractor return at a pre-established date to complete the necessary work using the same manufacturer's product. Earlier filling will result in greater separation and will lead to the need for more substantial correction; this separation does not indicate a failure of the filler.

For cold-storage and freezer-room floors, joint fillers specifically developed for cold temperature applications should be installed only after the room has been held at its planned operating temperature for at least 48 hours. For freezer rooms with operating temperatures below 0 °F (–18 °C), the operating temperature should be maintained for 14 days before starting joint filling.

There should be an understanding between all parties as to when the joints will be filled and whether provisions should be made for refilling the joints at a later time when additional concrete shrinkage has taken place.

5.5.2 *Installation*—Elastomeric sealants should be installed over a preformed joint filler, backer rod, or other bond breaker as described in ACI 504R. Semirigid epoxy and polyurea joint fillers should be installed full depth in sawcut joints. Joints should be suitably cleaned to provide optimum contact between the filler or sealant and bare concrete. Vacuuming is recommended rather than blowing the joint out with compressed air. Dirt, debris, sawcuttings, curing compounds, and sealers should be removed. Cured epoxy and polyurea fillers should be flush with the floor surface to protect the joint edges and recreate an



At Fabco Caterpillar, in their steel track vehicle repair shop, they installed a heavy duty traprock floor topping in 1999 and the next year we installed our PFAC I joint filler – a Durometer D64. In all the joints after they had experienced many joint failures from the heavy weighting on the steel treads that collapsed the joint edges. As seen below while some of the traprock continues to be broken the joint filler remains solid unaffected by the very heavy loading.

INMAR CORP.

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REPAIR OF JOINT PULLAPART

Repair of joints when they are pulled apart can be relatively straightforward or complex depending on the degree of separation.

Separation is usually from one of three causes:

1. The new concrete has continued to dry out and shrink (as described above) and the pour joints (most usually) shrink and pull apart.

2. The concrete slabs move up and down and so break the bond of the joint filler against the joint wall. This us usually a result of a hole under the slab and the slab moving as a result of a heavy load going over the joint making it move or in correct compaction (or perhaps undersurface erosion) causing the soil compaction to be in complete so when a heavy load goes over the joint the slab moves and compacts the underneath soil and upon rebounding heaves a hole.

3. The joint first had a foam rod put in it and then a minimum of joint filler installed over it. Loads over time will compress the joint filler materials and push the foam rod down and cause the joint filler to break off both sides of the joint wall. The use of a foam rod with less than 2" of joint filler over top of it should not be allowed as breakage of the joint edges is almost certain to happen.

In situation 1 where the joint materials is substantially broken from the joint wall removal of the joint materials, introduction of a solid backing materials (sand is a good idea) under the to be replaced joint materials and refilling the joint is recommended.

In situation 2 stabilizing the slab with mud jacking or other sub surface remedies needs to be done first. If the movement is minimal often deeply cutting into the joint- 2" or more- and refilling the PFAC often "glues the slab together" in normal use. There is no guarantee this will work but it is a good first step and often does work. If in normal use the slab does not move – this can be felt by straddling the joint and having a loaded fork truck drive over the joint. Movement can be readily felt in the feet this way.- simply patching in the open edges of the pulled apart joint with an epoxy paste is sufficient to once again seal the joint.

In situation 3 total removal and replacement of the joint materials is essential as the foam rod will continue to depress in use and the joint will continue to break. This construction is especially bad (and is expressly disallowed) in food plants as it can allow black mold to grow under the foam rod and then the joint breaks mold can spread into the work area.