2021

SR59 2021 Sealant Test Section Evaluation Report

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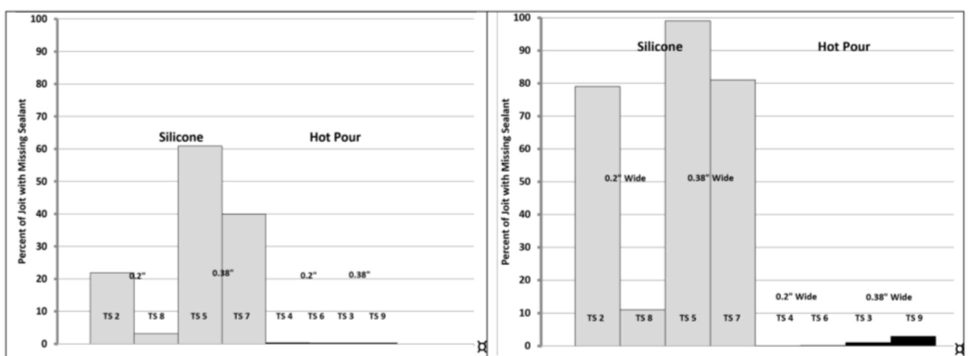
It appears the narrow joint design protects better against vertical loading on the sealant during inclement weather or winter maintenance operations.

TABLE 1 Percent of Joint Sealant Missing from Transverse Joint



2013 Field Evaluation Percent of Joint Sealant Missing or Depressed

2021 Field Evaluation Percent of Joint Sealant Missing

International Grooving & Grinding Association

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Introduction

In 2009 test sections were constructed on SR59 near Plainfield, Illinois to evaluate the effectiveness of joint sealing on PCCP performance. The joint sealant test sections were installed on a newly constructed PCCP project consisting of a four lane facility through an urban area with curb and gutter and several intersections within the project limits. The pavement section consisted of 9 ¾ inch thick dowelled PCCP placed upon a twelve inch thick base. The aggregate base consisted of 9 inches of crushed PCCP plated with 3 inches of AC millings. Joints were spaced at 15 ft. intervals. The two south bound lanes were constructed first and contain the sealant test sections. The sealant test sections were constructed in October/November of 2009. The Northbound roadway, which was not part of the sealant test sections, was constructed in 2010.

Sealant Test Section Layout

Figure 1 indicates the sealant test section layout. As indicated in Figure 1, two sealant types (i.e. hot pour and silicone) were installed in each of two joint geometries; a narrow cut configuration and a reservoir cut configuration. The reservoir cut opening width was cut 3/8 inches wide while the narrow cut opening was cut 0.2 inches wide. Each test section consists of 33 panels in length or approximately 495 ft. For each sealant test section, the longitudinal and transverse joints were constructed to the same width and sealed with the same material. On the north end of the project, IDOT had also constructed an early entry saw experiment which was independent of the SNS sealant test sections.

Four sealed test sections were constructed at each of two locations (e.g. TS2-TS5 and TS6-TS9). The remainder of the project was constructed using a single saw cut design and unsealed transverse joints. The silicone sealed sections are indicated in yellow shading and the hot pour sealed sections indicated in blue shading. The two locations labeled as “project std.” (e.g. TS1 and TS10) represent the control sections which use the standard project design of narrow cut unsealed transverse joints and sealed longitudinal joints. TS10 is co-located with the early entry saw experiment conducted by the Illinois Department of Transportation. The same control section (e.g. TS10) will be used for both experiments. The TS10 section is slightly shorter in length (e.g. 300 ft) than the other SNS test sections (e.g. 495 ft).

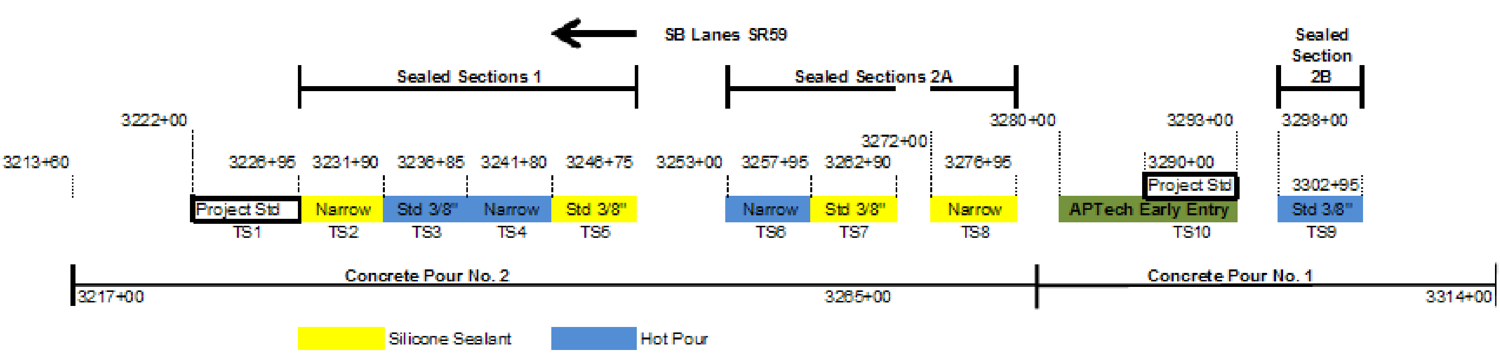


Figure 1 SR59 Sealant Test Section Layout

Structural Section and Construction Process

The structural section consists of 9 ¾ inches of concrete placed on 12 inches of aggregate base. The 12 inches of aggregate base consists of 9 inches of PGE (crushed concrete up to 6-inch fragment size) and 3 inches of AC millings. The millings plate the crushed concrete and provide the final base for the concrete. The joint spacing is 15 ft non-skewed joints. Epoxy coated dowel bars 1 1/2 inch in diameter by 18 inch long are placed on 12-inch centers. Dowel bars are held in place by baskets staked to the base.

Twenty -four inch long, epoxy coated tie bars were placed on 24-inch centers to tie the lanes together and the curb to the lanes. Number 6 tie bars were used to tie the curb to the lanes and number 8 tie bars used to tie the lanes together. The tie bars are placed into drilled holes that are epoxy filled.

The surface texture consisted of skewed random transverse tining.

Construction of the transverse and longitudinal joints was accomplished by Quality Saw and Seal. The initial cuts were constructed within 6 to 8 hrs after concrete placement. The joint widening and sealant installation occurred between October 12th and November 1st, 2009. The South bound roadway was opened to traffic on November 3, 2009. The concrete pavement is stationed every 200 ft in both directions near the outside curb.

The sealant installation process consisted of the following steps:

- Initial saw cut using a down-cut saw with 0.145 inch-blade width.
- Widen joints with down-cut saw followed by power wash:
  - For narrow joints, widen with a 0.20-inch-wide blade to 1.5 inches
  - For 3/8 inch wide joint, widen with two blades with spacer to establish and maintain cut width at 3/8 inch to a depth of 1.5 inches.
- Just prior to installing backer rod, sand blast joint faces and air blast residue.
- Install backer rod, and just prior to sealing, air blast debris from joint.
- Install sealant in joints.

At the time of construction, it was observed that every fourth or fifth joint opened wider. This occurred in all sections including the early entry one inch deep, the early entry T/3, and the conventional sawing at T/3. Due to the wider joints, Denver foam was used as the backer road material to accommodate the excessive width at these locations.

Field Evaluations

Since test section construction in 2009, several field evaluations have been conducted to date and are indicated below. The reports shown in the reference section can be consulted for additional information:

- May 23, 2010: Joint opening width measurements were obtained using a micrometer[1].
- September 25-26, 2013: Joint opening width measurements were obtained, and sealant evaluations conducted. In addition, FWD testing, GPR, and falling head permeameter testing was conducted[2].
- November 2009, March 2010, and August 2010, APTech evaluated the early entry saw test section (TS10) as part of the IDOT project[3].

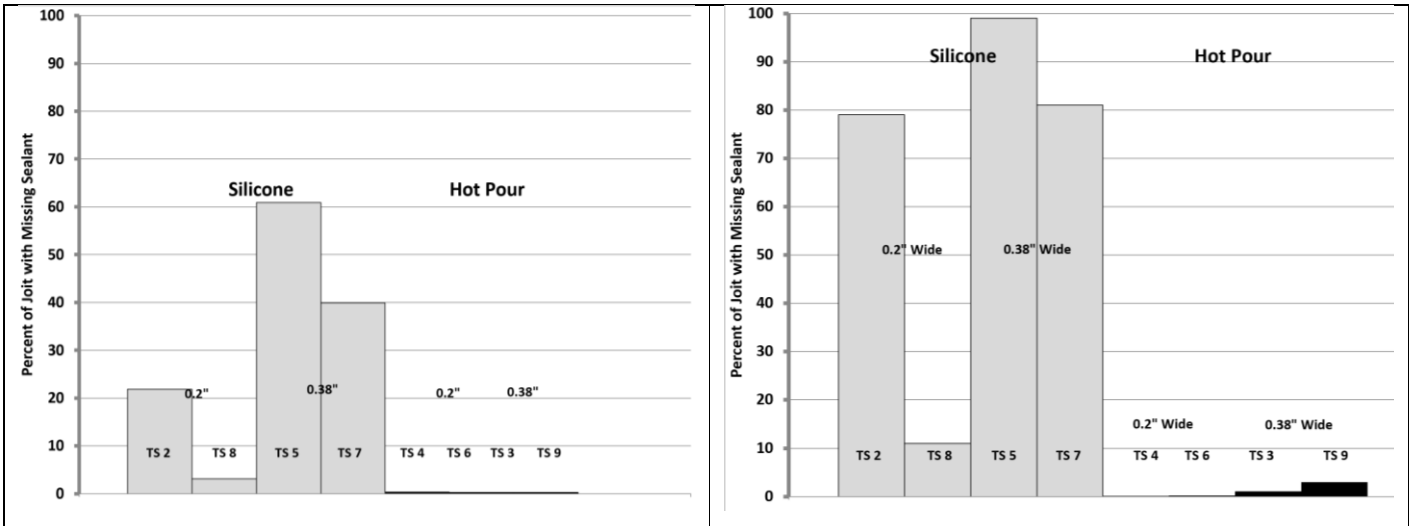
The field evaluation reported herein, was conducted on June 24th, 2021. During that week, the Chicago area had continual rain events and it rained the day of the evaluations. Temperatures were in the low 70s and conditions were very windy- see Figure 1. Once the rain subsided the pavement was allowed to “dry out” by traffic and the evaluations resumed. However, the joints retained water throughout much of the evaluation period. Although sidewalk is shown in Figure 1, which is on the north end of the project, most of the test areas do not have sidewalk. For the joints where 100% of the sealant existed or was missing, it was possible to rate the joint sealant from the curb location. When only partial sealant existed, it required viewing from the travel lane which often required waiting for the traffic signal to change due to the traffic volumes.

Figure 1 Photo of Intermittent Showers Occurring During the Sealant Evaluation

The evaluation consisted of only a visual assessment of the length of sealant remaining in the transverse joint of the outside lane. No actual measurement devices were used. Originally, it was planned to measure the joint opening widths of the two unsealed test sections with calipers. Due to the windy conditions, it was decided to do this after the sealant evaluations, but it began raining again before this could occur.

2013 and 2021 Sealant Evaluation Results

A visual assessment of the transverse joints was conducted in 2013 and 2021 for missing or depressed sealant. The visual joint sealant results are indicated in Figure 2. The columns in Figure 2 indicate the percent of sealing that is missing from the transverse joints in the outside lane of each test section with sealant installed. As indicated, the hot pour sealants performed significantly better in the 2013 and 2021 evaluations than the silicone. Similarly, the narrow joint design significantly outperformed the more traditional wider joint design. This is somewhat ironic since the narrow joint used had a significantly worse shape factor. With that said, the question arises whether the narrow joint width protects better against vertical loading on the sealant during inclement weather or winter maintenance operations. The original shape factor research did not consider vertical loading on the sealant[5].



2013 Percent of Joint Sealant Missing or Depressed	2021 Percent of Joint Sealant Missing

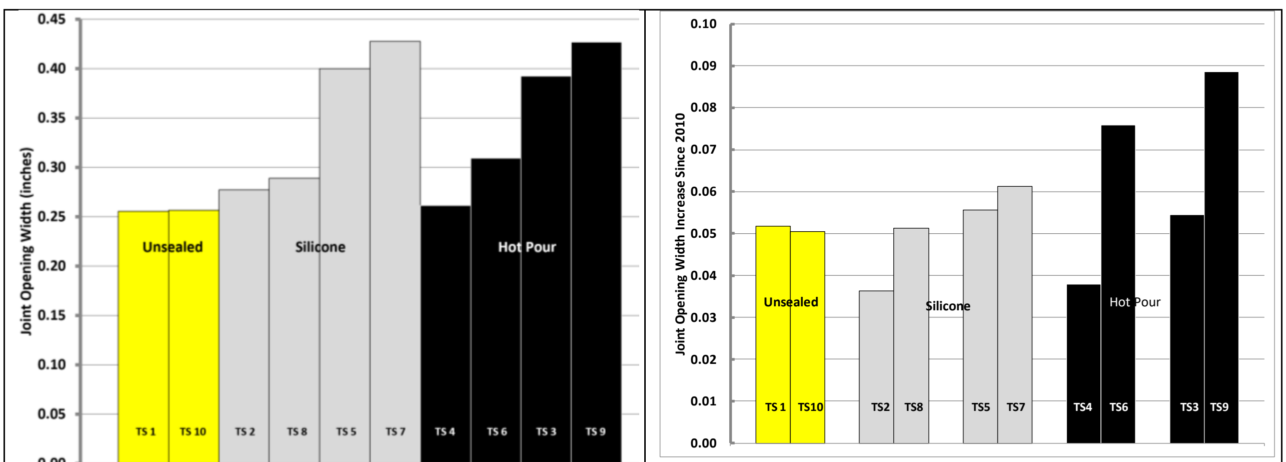
Figure 2 Percent of Joint Sealant Missing from Transverse Joint

Previous Joint Sealant Evaluation Results

Joint Opening Width Analysis

The left-hand side of Figure 3 indicates the average joint opening width for each test section in 2013. As indicated, the unsealed sections have the most consistent results as would be expected. The difference between the replicates for the other sealed configuration, particularly the hot pour, are impacted by the ability to correctly measure the width due to the presence of the sealant.

The right-hand side of Figure 3 indicates joint opening width increases between May 2010 and September 2013. The increase ranged from approximately 0.04 to 0.09 inches. On May 23, 2010, the temperate ranged from 75 to 90 degrees and on Sept 25 & 26, 2013 it ranged between 53 and 75 degrees during joint opening measurements.



Average Joint Opening Width In September 2013	Average Joint Opening Width Increase Since May 2010

Figure 3 September 2013 Joint Opening Width and Increase in Width Since May 2010

Shape Factor Analysis

In 2013, samples were extracted from selected joints to assess the shape factor of each of the different sealant/installation combinations. However, the shape factor for the narrow hot pour installation should only be considered a rough approximation of the actual shape factor. The bond of this sealant was still very good and sample extraction proved difficult and the extracted sample was always damaged and distorted to some degree. The actual shape factor is presumed to be somewhat better than what was measured.

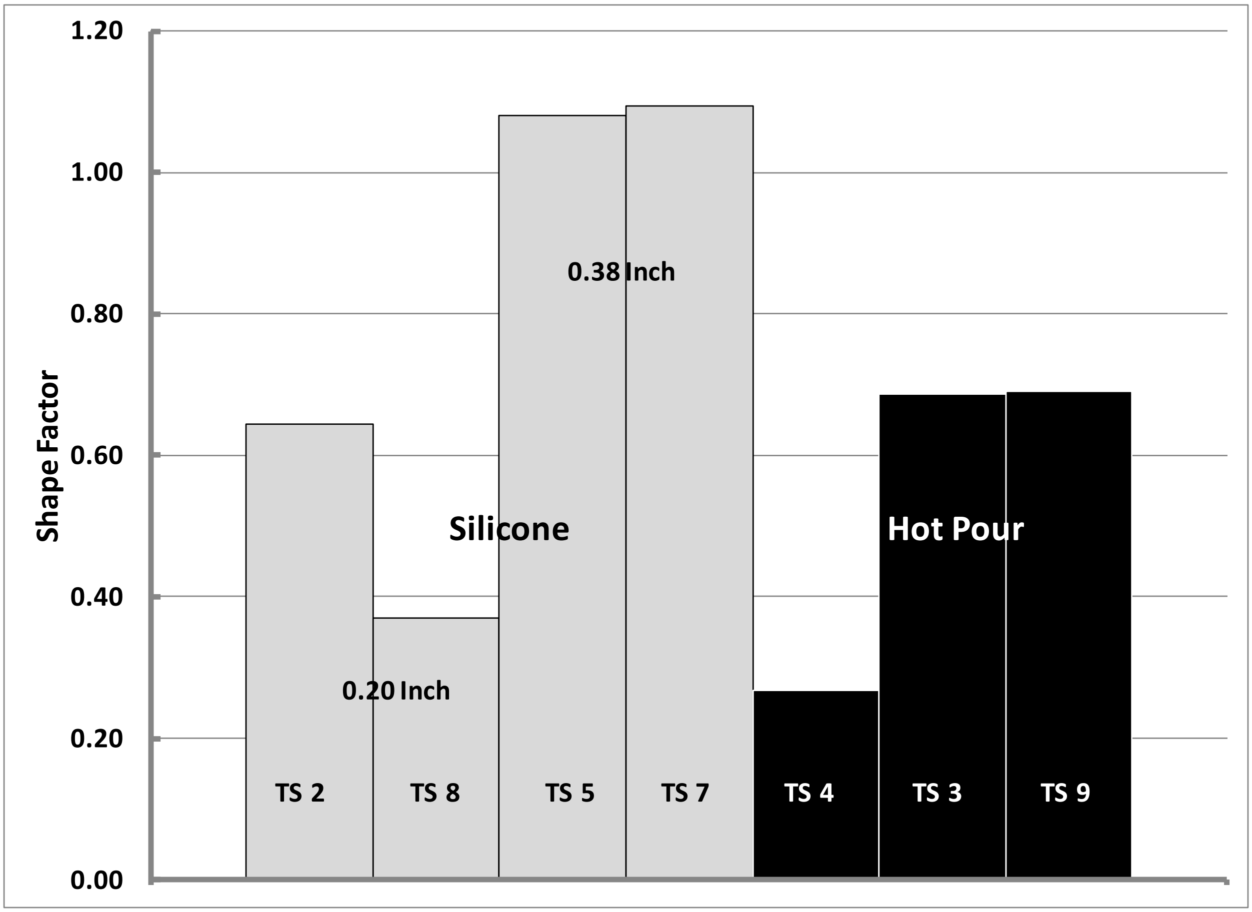


Figure 3 Shape Factor for Extracted Samples for Test Sections

Summary of Results

1. The performance of the sealant test sections, based on this review, ranked the narrow hot pour as the best, followed by the 3/8 hot pour, the narrow silicone configuration, and in last place by quite a margin, the 3/8 silicone sealant.
2. After only four years of service, approximately 50% of the silicone sealant in the 3/8-inch configuration was missing or nonfunctional, and by twelve years, 80% to 100% was missing.
3. The superior performance of the narrow joint width installations for both the silicone and hot pour joint configurations may be attributable to winter maintenance operations. That is, since the 3/8-inch configuration is significantly wider, the downward pressure exerted by the snow

during plowing operations, may make this configuration more prone to failure, particularly if inadequate bond was developed. The narrower configuration may be better designed to minimize the impact of vertical loading.

4. The hot pour installations were essentially flush filled configurations. This appears to maintain their good bond, particularly for the narrow configuration.

References

1. Scofield, L., "SR59 SB Roadway Joint Sealant Experiment", SNS Group, June 2010
2. Scofield, L., "2013 Sealant Test Section Evaluation Report", SNS Group, September 2013
3. Bakhsh, K., et al, "Qualification of Joint Sealant Effectiveness Regarding Jointed Concrete Pavement Performance," Texas A&M Transportation Institute, February 2016.
4. Krstulovich, et al., "Evaluation of the Long-Term Durability of Joint Cut Using Early Entry Saws on Rigid Pavements," Illinois Center for Transportation, FHWA-ICT-11-076, January 2011.
5. Tons, Egons, "Materials and Geometry in Joint Seals," Joint Highway Research Project, Purdue University, Lafayett, Indiana, 1958.

Appendix 1 Photos of Typical Test Section Joints

Figure 1-1 North End of Project Indicated Stationing and Date Constructed (8-24-09)

Figure 1-2 Backer Rod Floating Out from Bottom

Figure 1-3 Crack in Pavement, Spall at Curb, Spall in Transverse Joint where Tining Crosses, Note also cohesive failure in hot pour- This sealant would have been rated as 0% missing

Figure 1-4 Note Delamination Occurring and Lack of Tining on Right Side of Joint

Figure 1-5 Note That Backer Rod Continues to Bonds to the Sealant

Figure 1-6 Curb Damage and Construction Debris at Approximately 3232+00