TECHBRIEF

# Resealing Concrete Pavement Joints

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FHWA Contact: Shahed Rowshan, HRDI, (202) 493-3152

## Background

Resealing concrete pavement joints is a common pavement maintenance activity. Joint sealants reduce the amount of water entering the pavement structure and prevent incompressible materials from filling the joints. Water entering the pavement structure can lead to pumping, faulting, base and subbase erosion, and loss of support. Incompressibles can cause joint spalling, blowups, buckling, and slab shattering. To address the deficiencies in current joint resealing materials, designs, and practices, the Strategic Highway Research Program (SHRP) and the Federal Highway Administration (FHWA) sponsored the most extensive joint seal investigation ever undertaken. Between April and June 1991, 1,600 joints were resealed at 5 test sites using 12 sealant materials and 4 methods of installation. For 82 months, field performance data on the different sealants and installation methods were collected at each site.

## Objectives

The primary objective of this study was to evaluate the relative performance of the selected joint sealant materials. Other objectives were to determine the effect of selected sealant configurations and installation methods, and to identify sealant material properties and tests that correlate well with field performance.

## Key Benefits of This Research

The benefits of this study include the advancement of the state of the art in sealing and resealing joints in concrete pavements, more cost-effective maintenance operations, less exposure of highway workers to traffic, and fewer maintenance delays for the traveling public.

## Research Approach

Test sites were located on moderate- to high-volume, four-lane highway or interstate pavements in four climatic regions. Two sites were located in the wet freeze region to compare the effects of short and long jointed pavements on sealant performance. The sites were located on the following roadways:

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U.S. Department of Transportation
**Federal Highway Administration**

Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, VA 22101-2296

Interstate 17—Phoenix, AZ
Dry Non-Freeze Region

Interstate 77—Columbia, SC
Wet Non-Freeze Region

Interstate 25—Fort Collins, CO
Dry Freeze Region

Interstate 80—Grinnell, IA
Wet Freeze Region (Short-Jointed Portland Cement Concrete (PCC))

U.S. 127—Frankfort, KY
Wet Freeze Region (Long-Jointed PCC)

A total of nine sealant materials were used in the study:

- One ASTM D 3405 asphalt sealant: Koch 9005.
- Three low-modulus ASTM D 3405 asphalt sealants: (1) Crafco Roadsaver7 (RS) 231, (2) Meadows Sof-Seal 7, and (3) Koch 9030.
- Two ASTM D 3405 rubberized asphalt sealants: (1) Meadows Hi-Spec7 and (2) Crafco RS 221.
- Two self-leveling silicone sealants: (1) Dow Corning7 888-SL and (2) Mobay Baysilone 960-SL.
- One non-self-leveling silicone sealant: Dow Corning7 888.

Single installations were also made at the request of participating States for the following sealants: (1) Koch 9050 - Self-leveling, one-part polysulfide; (2) Mobay Baysilone 960 - Self-leveling silicone sealant; and (3) Crafco RS 903-SL - Self-leveling silicone sealant.

The four methods of installation were:

(1) Joint faces resawed and sealant recessed.

(2) Joint faces resawed and sealant overbanded.

(3) Joint faces plowed and sealant overbanded.

(4) Joint faces resawed and sealant flush-filled.

Ten evaluations were performed during the 82-month monitoring period. The following evaluation parameters were used:

- Partial-depth adhesion loss.
- Full-depth adhesion failure.
- Partial-depth spall failure.
- Full-depth spall failure.
- Overband wear.
- Stone intrusion.
- Partial-depth cohesive failure.
- Full-depth cohesive failure.

During each evaluation, a detailed examination and measurements were made at each joint to determine seal effectiveness.

## Key Findings

- Over the 82-month evaluation period, a significant amount of overall seal failure developed at the five test sites. Approximately 52 percent of the treatments exhibited at least 25-percent failure. The predominant distresses were adhesion loss and spall failure.
- Much higher amounts of partial- and full-depth spalling occurred in the colder regions on joints containing silicone sealants than on those containing standard, recessed rubberized asphalt sealant.
- Joints filled with silicone and hot-applied sealants experienced less partial- and full-depth spall failure in the warmer regions.
- When installed in identically prepared joints using the standard, recessed configuration, the silicone sealants developed significantly less partial-depth adhesion failure than the hot-applied sealants.
- In the standard, recessed configuration, the silicone sealants outperformed all hot-applied sealants in full-depth adhesion failure at three sites. Although the Koch 9005 hot-applied sealant exhibited the same full-depth adhesiveness at two sites, the remaining hot-applied materials developed more adhesion failure.
- When the same installation methods are used, the evaluated silicone sealants are more cost-effective on long-term resealing projects than the hot-applied sealants.
- Based on 60 joint seals at the Iowa site, no significant differences in sealant adhesion failure, spall failure, and overall failure were found to exist among primed and unprimed joints containing the same sealant. The same was true at the Kentucky site with the Koch 9005 asphalt sealant.

## Recommendations

- Overbanding of hot-applied sealants using a squeegee notched 3 mm by 35 mm showed better results than recessed and flush-filled joint seals. This is recommended, especially for low-volume roadways.

- Sandblasting of each joint face was used at all sites with good results, especially with silicone sealants. Single sandblast passes should be avoided. Dual passes are recommended. Jigs or other methods of reducing operator fatigue and ensuring that the sandblast nozzle is properly positioned are recommended.
- Nozzles or tooling devices are recommended to ensure that silicone sealant is installed from the bottom of the joint and that it is not exposed to traffic.
- For resealing projects that are designed to be overlaid in less than 6 years, good-performing hot-applied sealants, such as Crafco RS 231 and Koch 9005, are recommended.
- The ASTM D 3583 tensile adhesion test correlated well with adhesion failure in the field, in both the hot-applied and the silicone sealants. Performance-based acceptance testing of silicone sealants using the non-immersed ASTM D 3583 tensile adhesion test is recommended.
- Overall seal failure and estimated service life related well with the ASTM D 113 maximum elongation and the ASTM D 3583 tensile adhesion test for hot-applied sealants and are recommended for use as an indicator of field performance.

## Service-Life Comparison

In addition to the evaluation of overall seal performance, a service-life comparison was performed. A 75-percent overall effectiveness level for each joint was selected to define failure. A joint with an overall effectiveness greater than or equal to 75 percent was classified as surviving. A joint with an overall effectiveness of less than 75 percent was classified as failing. Nearly 50 percent of the joints had reached the 75-percent effectiveness level at the time of the last evaluation, allowing for interpolation of the service life. All remaining joint performance service lives were extrapolated, limited by a maximum allowable time of 200 months. Table 1 (on the following page) represents the service life, or the time to 75-percent effectiveness, for the materials used in the study. Data from the single applications of Koch 9050, Mobay Baysilone 960, and Crafco RS 903-SL were not used in the service-life analysis.

## References


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**Table 1.** Projected Service Life in Months for Tested Joint Sealants

| Sealant Material | Configuration[1] | Time at Which 75% Effectiveness Level Was Reached in Months | | | | | |
|---|---|---|---|---|---|---|---|
| | | Arizona ADT=10K[2] | Colorado ADT=27K | Iowa ADT=19K | Kentucky ADT=14K | South Carolina ADT=19K | Average |
| Koch 9005 | 1 | 116 | 66 | 94 | 156 | 63 | 99 |
| | 2 | 112 | 66 | 91 | 191 | 90 | 110 |
| | 3 | | | 148 | 182 | 49 | 126 |
| | 4 | 105 | 61 | | | | 83 |
| Crafco RS 231 | 1 | 52 | 80 | 76 | 86 | 92 | 77 |
| | 2 | 135 | 69 | 118 | 108 | 138 | 114 |
| | 3 | | | 103 | 155 | 80 | 113 |
| | 4 | 83 | 72 | | | | 78 |
| Meadows Sof-Seal | 1 | | 34 | 40 | 39 | 55 | 42 |
| | 2 | | 40 | 51 | 64 | 46 | 50 |
| | 3 | | | 57 | 161 | 31 | 83 |
| | 4 | | 43 | | | | 43 |
| Koch 9030 | 1 | | 31 | 50 | 60 | 41 | 46 |
| | 2 | | 32 | 63 | 50 | 58 | 51 |
| | 3 | | | 59 | 143 | 15 | 72 |
| | 4 | | 37 | | | | 37 |
| Meadows Hi-Spec | 1 | 43 | | | | | 43 |
| | 2 | 94 | | | | | 94 |
| | 4 | 76 | | | | | 76 |
| Crafco RS 221 | 1 | 65 | | | | | 65 |
| | 2 | 105 | | | | | 105 |
| | 4 | 117 | | | | | 117 |
| Dow 888 | 1 | 198 | 145 | 130 | 186 | 178 | 167 |
| Dow 888-SL | 1 | 183 | 110 | 125 | 164 | 186 | 154 |
| Mobay 960-SL | 1 | 194 | 93 | 65 | 115 | 168 | 127 |

[1]The four installation configurations used were:
Method 1 = Joint faces resawed and sealant recessed. Method 2 = Joint faces resawed and sealant overbanded.
Method 3 = Joint faces plowed and sealant overbanded. Method 4 = Joint faces resawed and sealant flush-filled.

[2]Two-way average daily traffic (ADT), vehicles per day

Researcher: This study was performed by ERES Consultants, Inc., 505 West University Avenue, Champaign, IL 61820-3915. Contract No. DTFH61-93-C-00051.

Distribution: This TechBrief is being distributed according to a standard distribution. Direct distribution is being made to the Resource Centers and Divisions.

Availability: This publication from which this TechBrief was developed—*LTPP Pavement Maintenance Materials: SHRP Joint Reseal Experiment, Final*—will be published in 1999. For more information on the status of this report, contact Shahed Rowshan at (202) 493-3152. When published, copies will be available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. A limited number of copies will be available from the R&T Report Center, HRTS, FHWA, 9701 Philadelphia Court, Unit Q, Lanham, MD 20706, Telephone: (301) 577-0818, Fax: (301) 577-1421.

Key Words: Joint reseal, pumping, faulting, base and subbase erosion, loss of support, incompressibles, low modulus, self-leveling, partial-depth adhesion loss, full-depth adhesion failure, partial-depth spall failure, full-depth spall failure, overband wear, stone intrusion, partial-depth cohesive failure, full-depth cohesive failure.