

# Impact of Joint Sealing Effectiveness on Concrete Pavement Performance

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International Grooving and Grinding  
Association



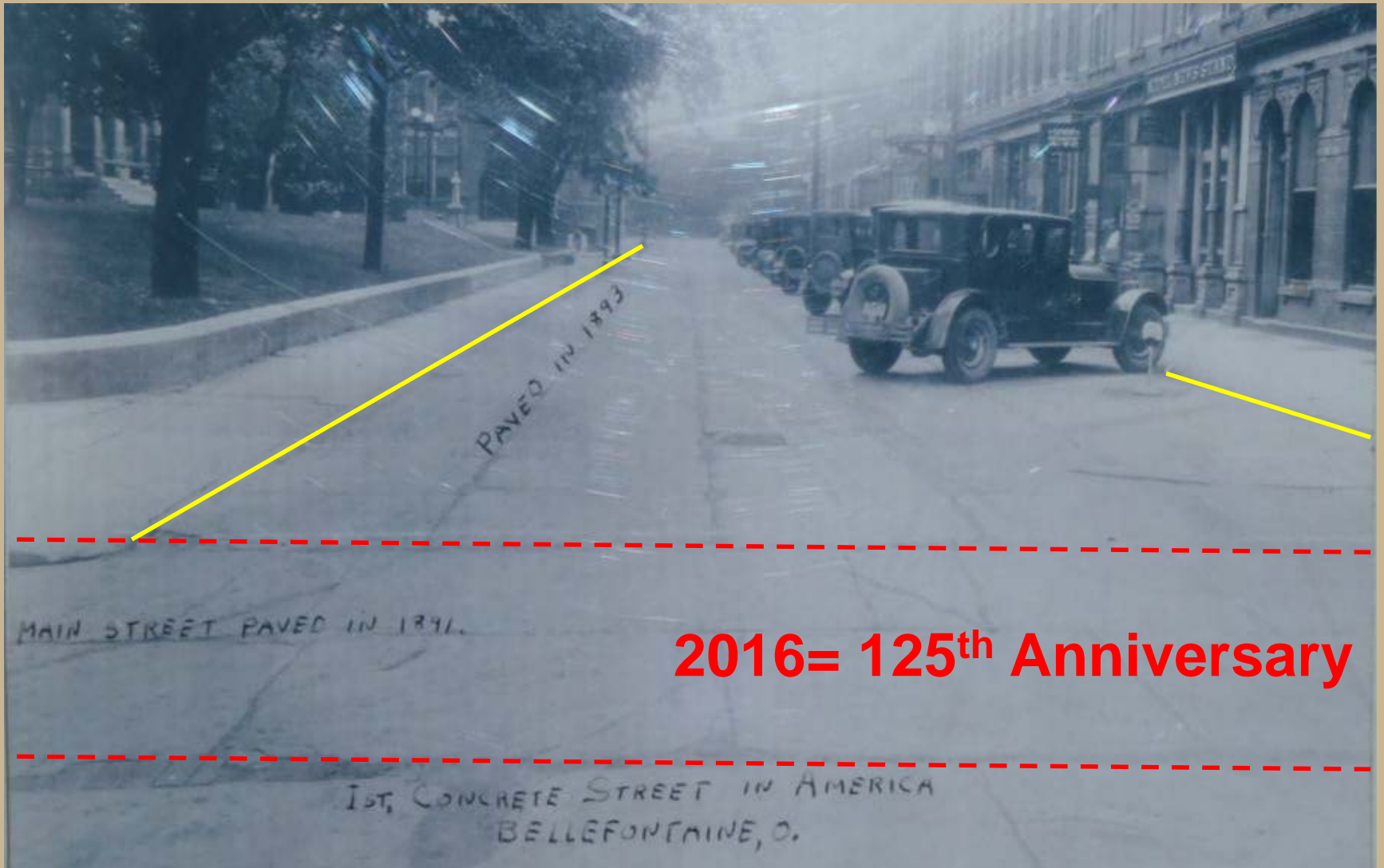
**IGGA**

International Grooving  
& Grinding Association

Your Pavement Preservation  
Resource since 1972

# Why Concrete Pavement Preservation

Bellefontaine, Ohio 1925



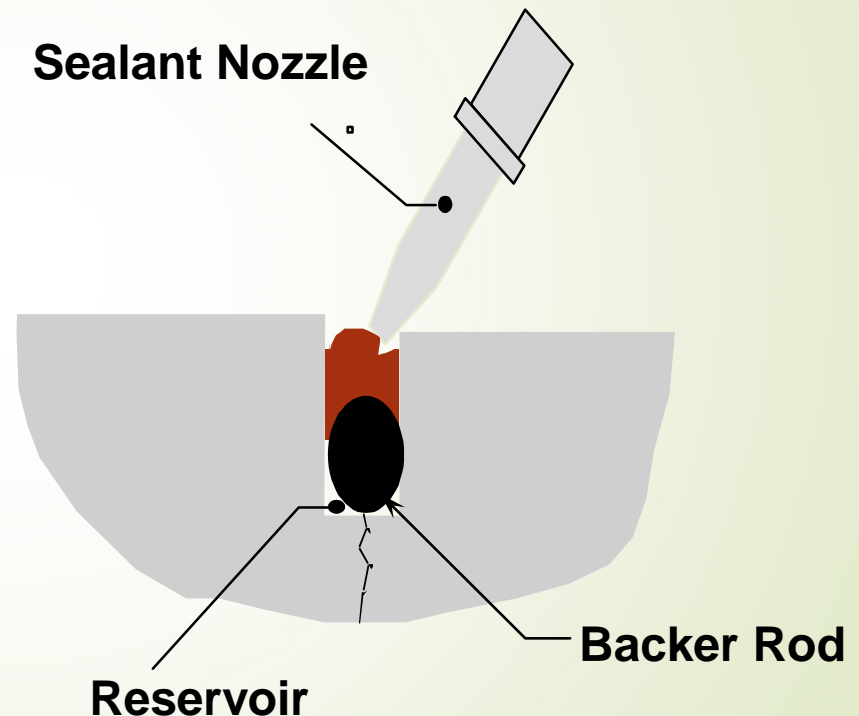
# Presentation Outline



- Why do we seal?
- Field Performance Issues
- Sealant Life and When to Reseal
- Design of Joint Sealant Installation
- Sealant Selection and Installation
- Can We Seal Joints?
- How Does Sealing Impact Pavement Performance

# Reasons for Joint Resealing

- Minimizes water & incompressibles into pavement system
- Reduces subgrade softening, pumping and erosion of fines and spalling
- Prevents Joint Associated Distress?
- Reduces Noise (Joint Slap)





# Field Performance?



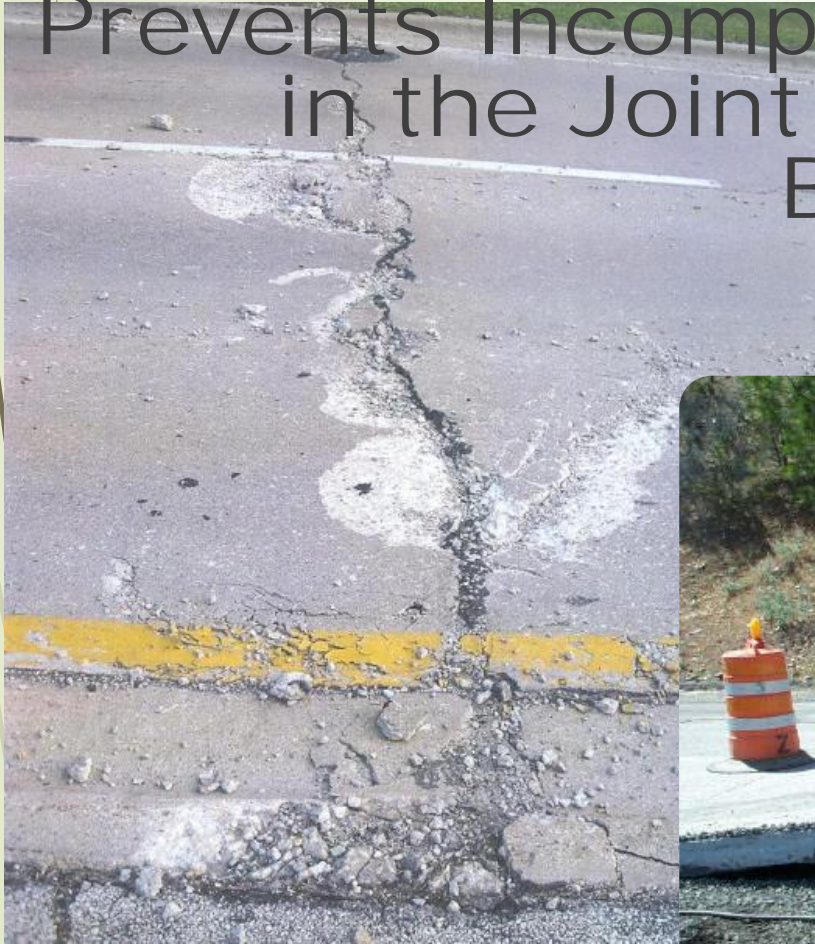
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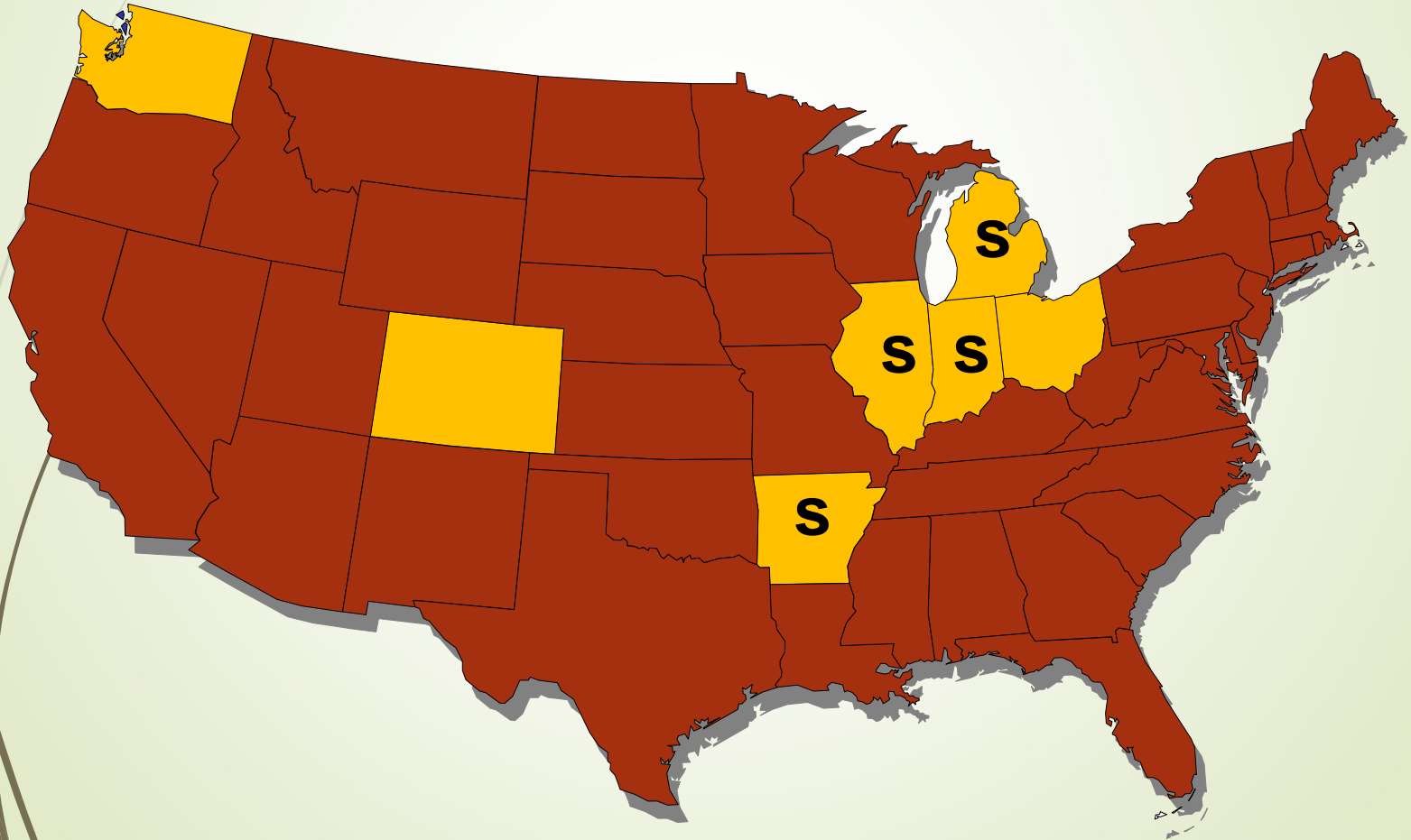


# Why Seal Joints and Cracks

Prevents Incompressible from Lodging in the Joint — Slab Growth and Blow Ups



# States With Examples and Studies

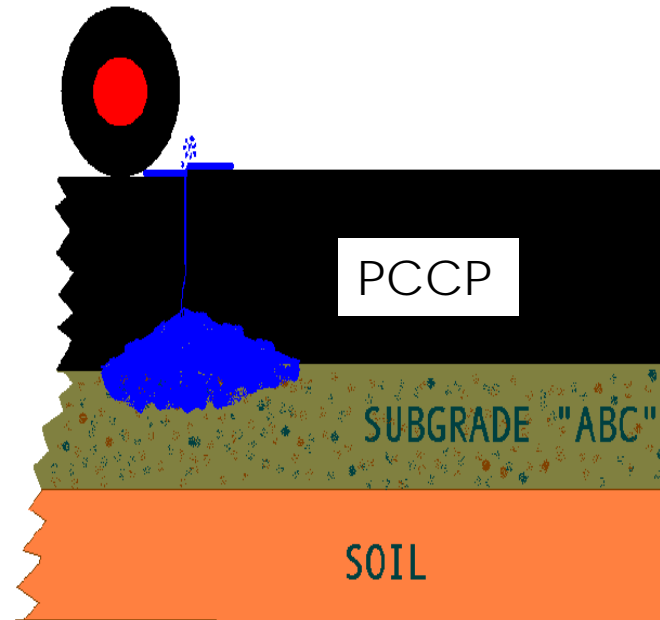




# Why Seal Joints and Cracks

Prevents Water from Entering the Subgrade:

- Prevents subgrade erosion
- Voids beneath the slab



# Water Damage to Pavements





# The Top Doesn't Always Tell the Story





# Joint Associated Distress



# When to Reseal & Sealant Longevity

- Adhesive Failures
- Cohesive Failures
- % Damaged or Missing

**When the Sealant is No Longer Serving its Intended Function**





# Reseal or Original Seal?



# Defining Sealant Life

## LTPP Pavement Maintenance Materials: SHRP Joint Reseal Experiment, Final Report

PUBLICATION NO. FHWA-RD-99-142

SEPTEMBER 1999

Crafco 221 = 5.4 – 9.8 yrs  
Crafco 231 = 6.4 – 9.5 yrs  
Dow 888 SL = 12.8 yrs  
Dow 888 = 13.9

232% to 348% Increase for  
Silicone



U.S. Department of Transportation  
Federal Highway Administration

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

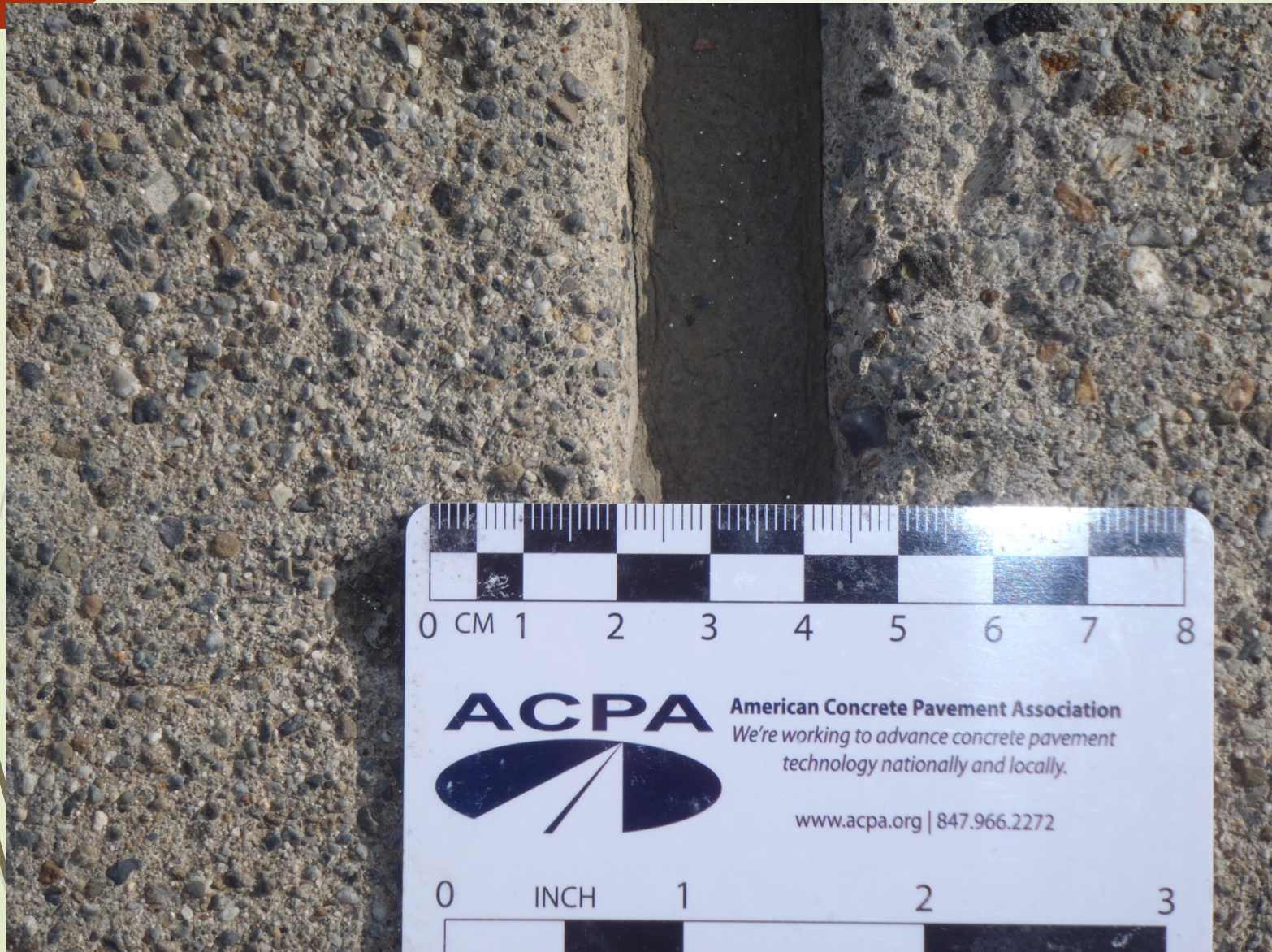


Sealant Material	Config-uration	Time at Which 75% Effectiveness Level Was Reached, months *					
		Arizona	Colorado	Iowa	Kentucky	South Carolina	Average
Koch 9005	1	116	66	94	156	63	99
	2	112	66	91	191	90	110
	3			148	182	49	126
	4	105	61				83
Crafco RS 231	1	52	80	76	86	92	77
	2	135	69	118	108	138	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
Mobay 960	1			143			143
Crafco 903-SL	1	194					194
Koch 9050	1		19		136		78
Dow 888 w/ primer	1			151			151
Dow 888-SL w/ primer	1			143			143
Koch 9005 w/ primer	1				173		173

\* Times greater than 82 months are extrapolated to a maximum of 200 months.



# 20 Year Old Sealant In Airfield





# Same Airfield - One Year Old Sealant Installation





# Same 20 Year Old Airfield Sealant Installation



# Design of Sealant Installation



# Design of Sealant Installation

## Sealant Performance Depends On:

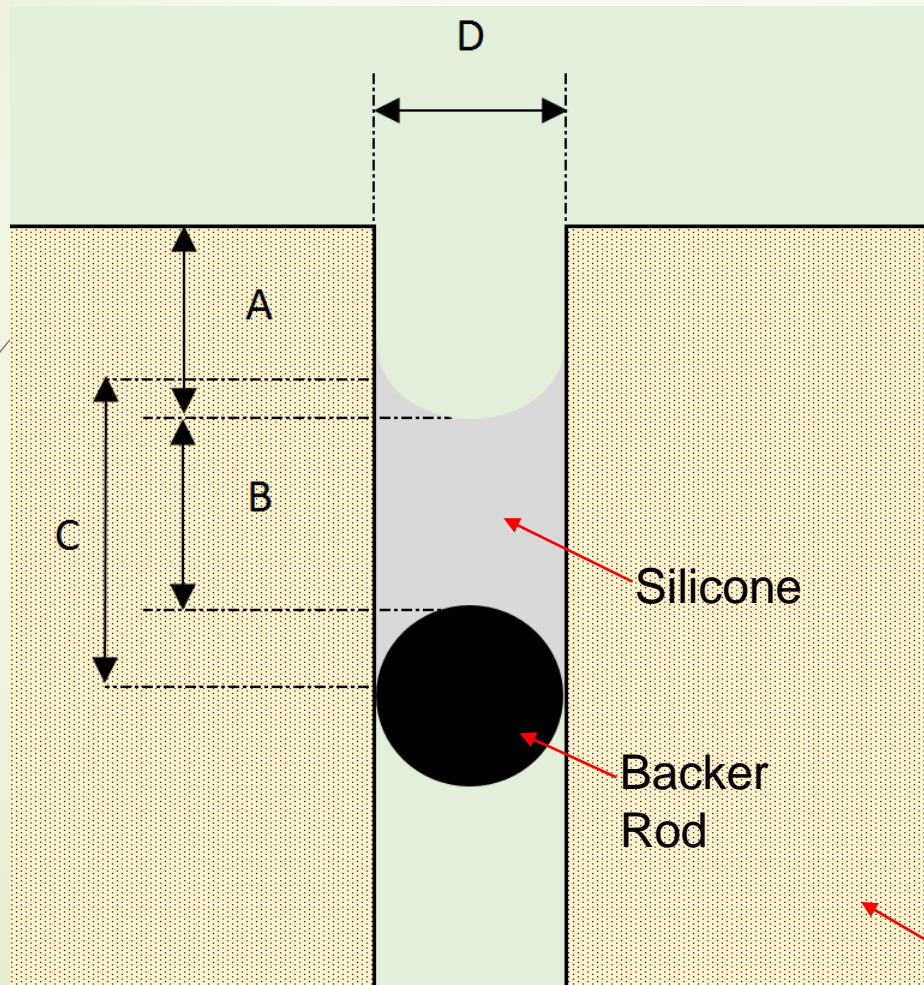
- ▶ Design Factors (See ACPA App Website)
  - ▶ Anticipated Movement
  - ▶ Construction Schedule and Installation Conditions
  - ▶ Required Performance Period
  - ▶ Noise Considerations
- ▶ Sealant Selection---Proper Design and Specification for Application
- ▶ Joint Preparation---Clean, Dry, and Bondable
- ▶ Sealant installation
  - ▶ Silicone & Compression Seal Should be Recessed
  - ▶ Hot Pour Should be Flush Filled
  - ▶ Backer Rods Appropriate for Sealant Type
  - ▶ Primer?



# **Allowable Joint Opening Movements (Compression/Extension)**

- ➡ **Hot Pour Sealants: 25% Extension**
- ➡ **Silicone Sealants: 50%  
Compression to 100% Extension**
- ➡ **Compression Seals: 15% min  
Compression to 50% Extension**

# Guidelines for Joint Design



- $A = \frac{1}{4}"$  to  $\frac{3}{8}"$
- $B = \leq \frac{3}{8}"$
- $C = \text{Min of } \frac{1}{4}"$
- $D/B \geq 2$
- $D \geq \frac{1}{4}"$



# Manufacturer Design Tables

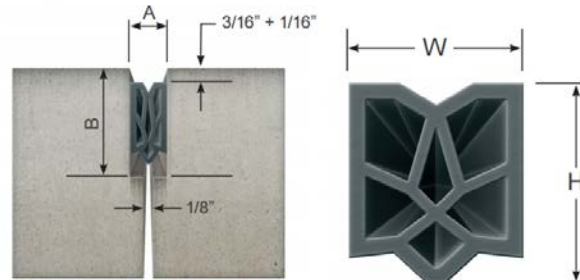
## Silicone and Compression Seal

*Joint Width	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	1 1/4"	1 3/8"	1 1/2"
Minimum Sealant Recess	1/4"	1/4"	5/16"	5/16"	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"	1/2"
Backer Rod Diameter <sup>1</sup>	3/8"	1/2"	5/8"	3/4"							
Sealant Bead Thickness	1/4"	1/4"	1/4"	5/16"							
Minimum Joint Saw/Reservoir Depth	1 1/8"	1 1/4"	1 1/2"	1 3/4"							
Minimum Backer Rod Depth	1/2"	1/2"	5/8"	11/16"							
Estimated Usage Non-Sag	245	149	112	70							
Estimated Usage Self-leveling(ft./gal)	273	172	130	82							

### Meeting Specifications

Delastic® Preformed Pavement Seals meet ASTM standard specifications. They are also recognized by the FHWA, U.S. Army Corps of Engineers, the U.S. Air Force, the FAA, consulting engineers and other agencies as an effective, long-lasting concrete pavement joint seal solution.

Delastic® Preformed Pavement Seals have been successfully used on high performance concrete pavements throughout the U.S. Many of these installations have protected pavements located in extreme hot and cold climates in excess of 20 years.



Typical joint design for the "E" and "V" series pavement seals



Airports, including military bases all over the world rely on Delastic® Preformed Pavement Seals.



40-year-old Preformed Compression Seal at DFW Airport.


### Delastic® Preformed Pavement Seal Characteristics

Delastic® Seal Catalog No.	Seal Characteristics			Joint Design Criteria			Typical Installed Width (A)**
	Nominal Width (W)	Nominal Height (H)	Max. Movement <sup>1</sup>	Narrowest Opening <sup>2</sup>	Widest Opening <sup>3</sup>	Minimum Depth (B)	
E-437	0.437 (11.11)	0.937 (23.81)	0.153 (3.88)	0.219 (5.56)	0.372 (9.45)	1.000 (25.40)	0.250 (6.35)
E-562	0.562 (14.29)	0.625 (15.88)	0.188 (4.78)	0.290 (7.37)	0.478 (12.14)	1.063 (27.00)	0.3125 (7.94)
E-686	0.687 (17.46)	0.687 (17.46)	0.259 (6.59)	0.325 (8.26)	0.584 (14.84)	1.188 (30.18)	0.375 (9.53)
E-816	0.812 (20.64)	0.830 (21.08)	0.313 (7.95)	0.378 (9.59)	0.691 (17.54)	1.438 (36.53)	0.500 (12.70)
E-1006	1.000 (25.40)	1.000 (25.40)	0.450 (11.43)	0.400 (10.16)	0.850 (21.59)	1.625 (41.28)	0.500-0.5625 (12.70-14.29)
E-1256	1.250 (31.75)	1.000 (25.40)	0.563 (14.30)	0.500 (12.69)	1.063 (26.99)	1.875 (47.63)	0.750 (19.05)
V-1625	1.625 (41.28)	1.125 (28.58)	0.631 (16.03)	0.750 (19.05)	1.381 (35.08)	2.250 (57.15)	0.875 (22.23)
E-2000	2.000 (50.80)	1.500 (38.10)	0.950 (24.13)	0.750 (19.05)	1.700 (43.18)	2.500 (63.50)	1.125 (28.58)
E-2500	2.500 (63.50)	2.500 (63.50)	1.125 (28.58)	1.000 (25.40)	2.125 (53.98)	3.375 (85.73)	1.375 (34.93)
E-3000	3.000 (76.20)	2.500 (63.50)	1.550 (39.37)	1.000 (25.40)	2.500 (64.77)	4.000 (101.60)	1.750 (44.45)

Above: First number shown in bold represents inches, metric dimensions (mm) are shown in parentheses. Notes: \*Thickness of the seal wall and internal web are not drawn to scale. <sup>1</sup> Maximum movement which seal will accommodate in joint with correct design. <sup>2</sup> A narrower opening will place excessive stress on the seal and may cause premature failure. <sup>3</sup> A wider opening may not provide sufficient compressive force to hold the seal in place. \*\* To be used as reference only. Installed width may vary by project.



# ACPA Joint Movement Estimator



LoginAppsR

## /// JOINT AND SEALANT MOVEMENT ESTIMATOR ///

### LOCATION DETAILS

State:

Location:

### CONCRETE MATERIAL DETAILS

Cement Type:

Cementitious Materials Content (lb/yd<sup>3</sup>):

Coefficient of Thermal Expansion (10<sup>-6</sup>/°F):

### CONCRETE PAVEMENT STRUCTURE DETAILS

Concrete Pavement Thickness (in.):

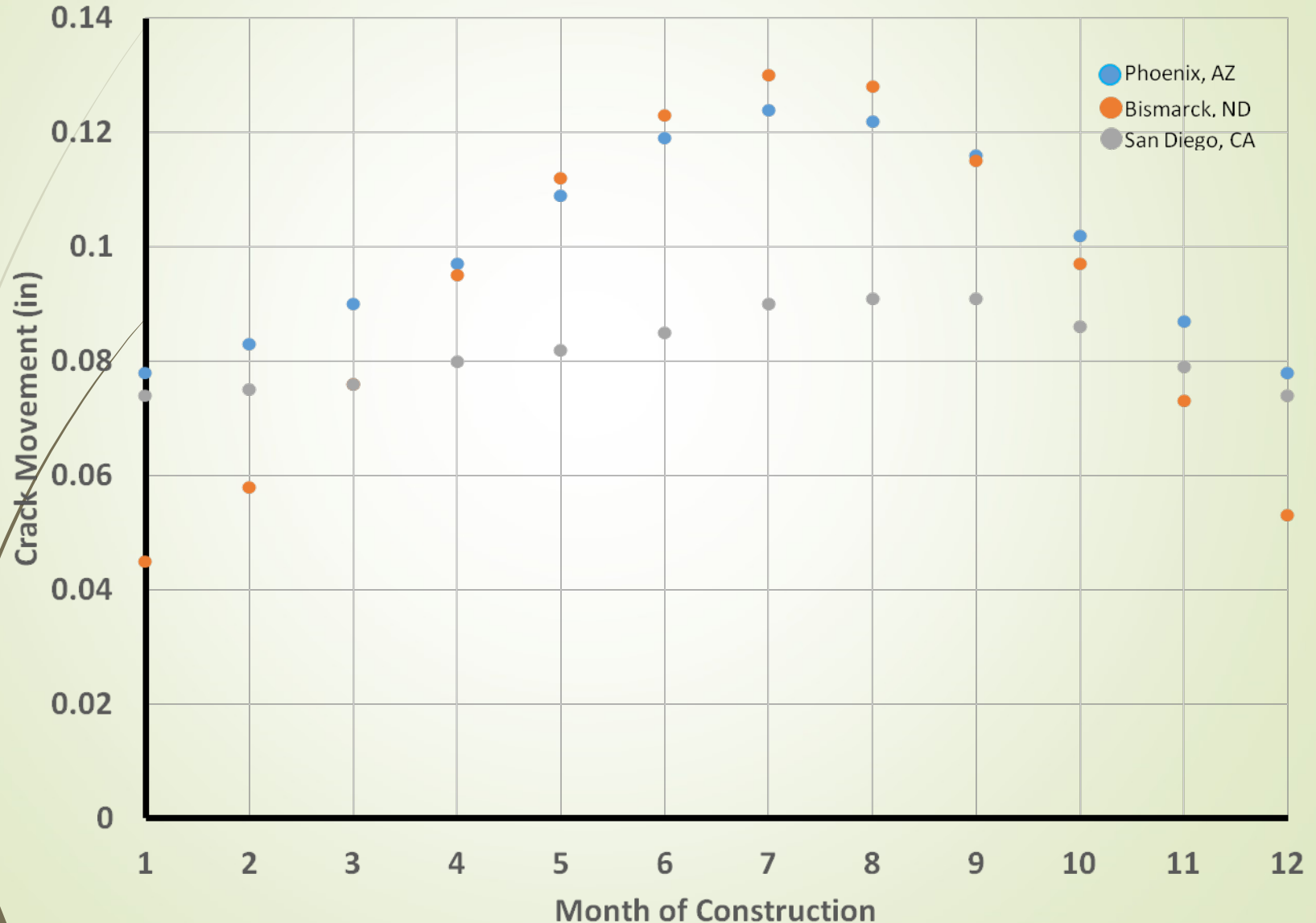
Transverse Joint Spacing (ft):

### CONSTRUCTION DETAILS

Month of Construction:

Curing Procedure:

# Crack Opening Width based on Time of Year of Placement





## Description

For passenger cars, 70% to 90% of the traffic generated noise is produced by the tire-pavement interaction. Thus, additional traffic generated noise due to such vehicles is well characterized through evaluation of just the tire-pavement interaction. In the U.S., this is accomplished with the use of On-Board Sound Intensity (OBSI; see image on the right in the header) per AASHTO TP-76.

As a vehicle travels over joints in a jointed concrete pavement, there is a joint slap noise that contributes to the overall tire-pavement noise. When evaluating pavements using OBSI techniques, it is generally only convenient to determine the overall pavement noise levels. These levels are a function of both the joint slap effect and the pavement texture effect.

This tool, based on the work of Dr. Paul Donavan<sup>1</sup>, was developed to allow designers to estimate the impact of various joint geometries and condition on the overall tire-pavement noise level and to provide guidance to maintenance efforts in terms of the noise benefit attainable through sealing joints.



## Joint Noise Estimator



**Joint Slap Adds 5 dBA to Overall Pavement Noise at 70 MPH**

### Concrete Pavement Details

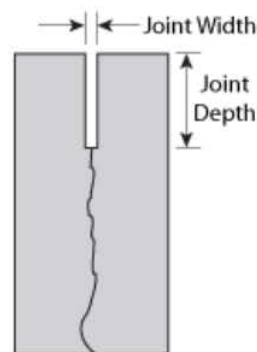
Joint Spacing (ft):

15

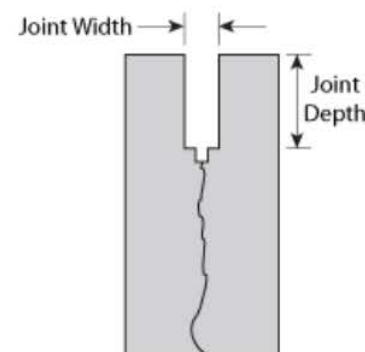
Joints Sealed:

☐ Yes

☒ No



Single Cut Joint



Reservoir Joint

Joint Width (in.):

0.625

Joint Depth (in.):

1.5

### Traffic and Pavement Texture Details

Vehicle Speed (mph):

70

# Sealant Material Selection

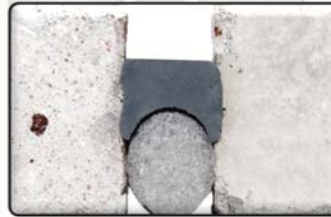
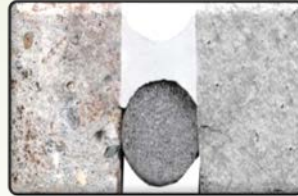




# Sealant Types

## ▶ Silicone

- ▶ Non Sag
- ▶ Self Leveling
- ▶ Rapid Cure

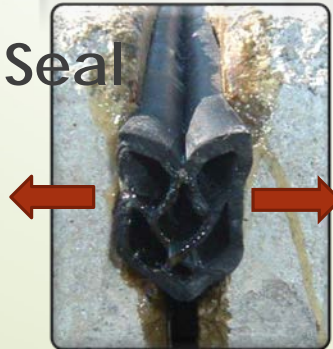


## ▶ Hot Pour

- ▶ Standard Modulus
- ▶ Low Modulus



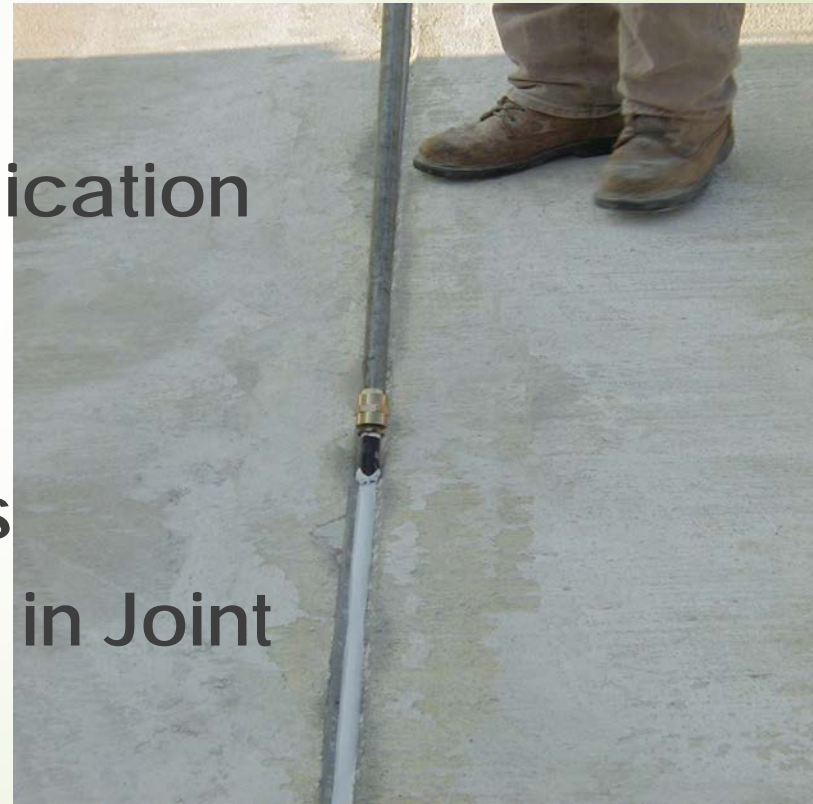
## ▶ Compression Seal



# NON-SAG SILICONE



- Light Gray
- Horizontal or Vertical Application
- Low Modulus
- Requires Tooling
- Rehab or New Pavements
- Seals Small Spalled areas in Joint Walls
- Tack Free in 25 to 90 mins.
- Full Cure through in 14 days





# SELF-LEVELING SILICONE



- Dark Grey
- Horizontal Application Only
- Ultra Low Modulus
- Neat Seal-No Tooling
- Rehab or New Pavements
- Tack Free in 3 hours max
- Full Cure through in 21 days
- 6% maximum grade
- AC/PC Joints ???

# Asphalt Hot Pour Joint/crack Sealants



- ASTM D-6690:

Type I - ASTM D1190

Type II - ASTM D 3405

Type III – Low Modulus

Type IV - Fed Spec SS-S-1401C

FAA P 605-ASTM D-6690

State Specifications



# Compression Seal



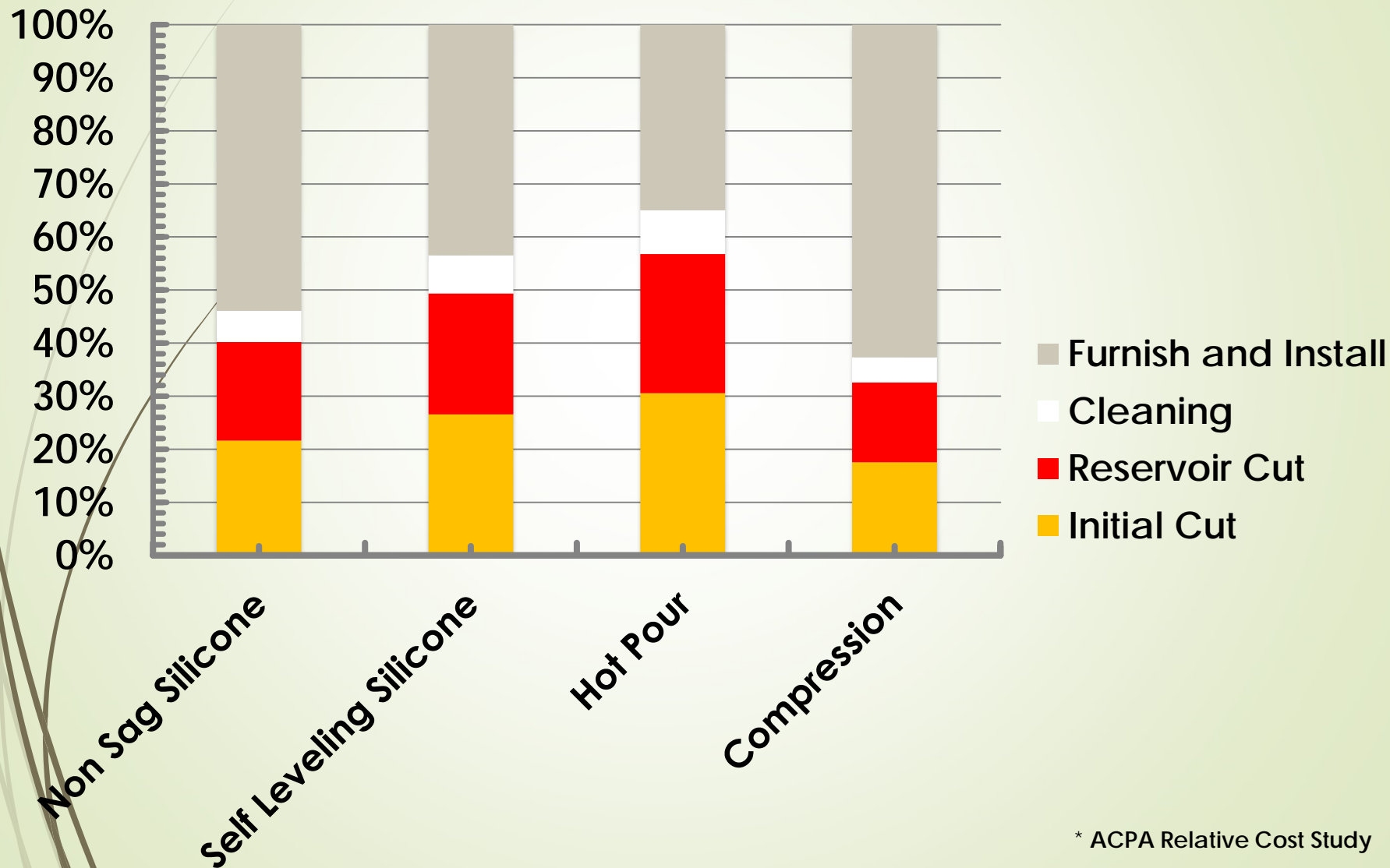
- Extruded from compounds of neoprene (polychloroprene) which meet or exceed current ASTM standard specifications
- Uses adhesive/lubricant for installation
- Requires proper installation equipment



# Cleaning Joints



# Percent of Total Cost For Each Operation of Sealing a Joint\*





# Clean Isn't an Option

▶ Finger Test





# Power Washing After Green Sawing





# Intersecting Joints After Power Washing





# Media Blasting



# Media Blasting

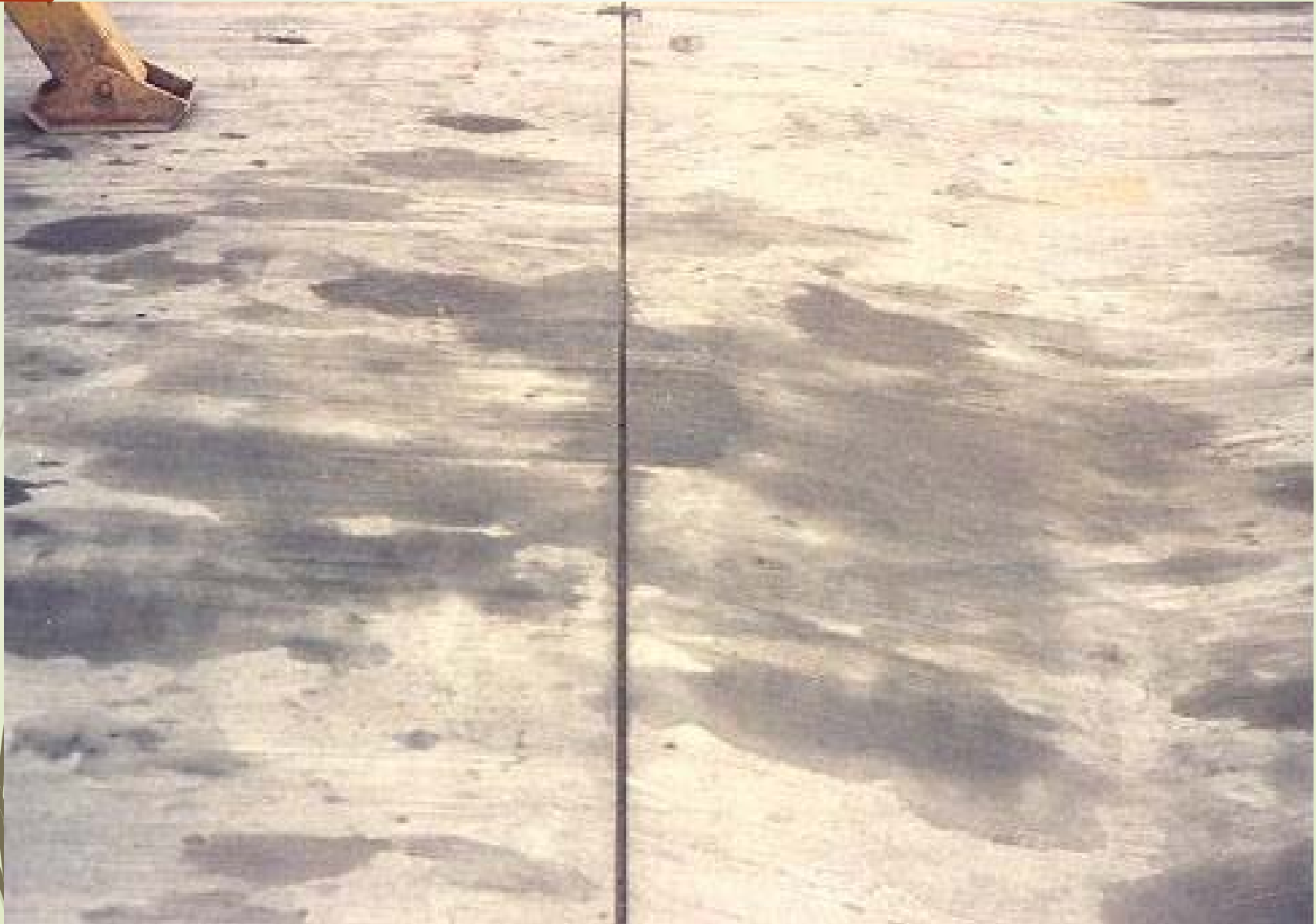


# Keeping Joints Cleaned and Protected After You've Cleaned Them.....





# Do You Know Where Your Oil is?



# Keep the Joints Clean During Construction



# Early Traffic Damage





# Installing Sealant Systems



# Inserting and Rolling Backer Rod



## BACKER ROD

- ▶ 25% Larger than Joint
- ▶ Cold Rod/Hot Rod
- ▶ Closed Cell Backer Rod
- ▶ Do Not Puncture Backer Rod-bubbling
- ▶ Do Not Stretch Backer Rod



# Inserting and Rolling Backer Rod





# Installing Backer Rod





# Hot Pour Joint Sealant Configuration

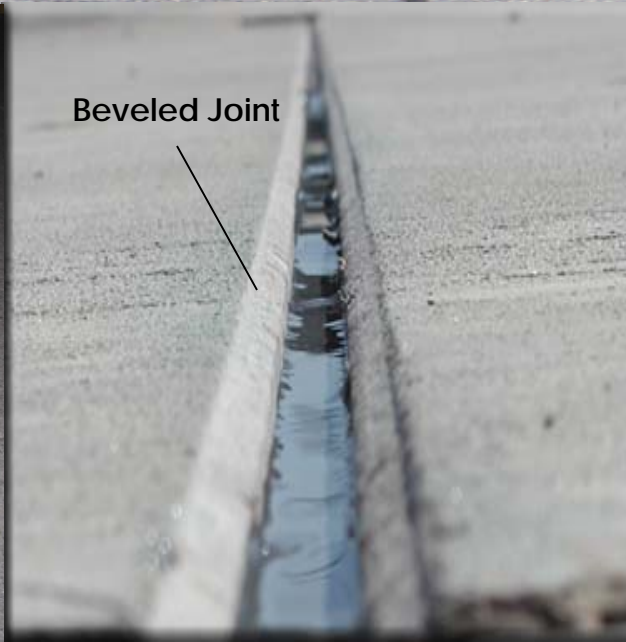
40° F Minimum Pavement Temperatures  
Flush Fill, Recessed or Over-band -->



Flush Filled

Recessed

Flush Filled





# Installing Hot Pour Sealants





# Silicone Joint Sealant Configuration

Non-

Leveling



## Jet Fuel Resistance Testing – Airfield Applications

As stated in FAA Engineering Brief No. 36 (dated 5/86), "The function of a sealant is to seal the joint between two concrete surfaces." Therefore, the sealant's strength characteristics are less important than its ability to seal against joint movement and maintain adhesion." This document goes on further to state that "silicone sealant is not degraded by contact with jet fuel. Some swelling of the material will normally occur, but it will return to its original shape upon evaporation of the fuel, without loss of bond."

Generally, for a sealant to be successful in an airfield application, it must meet the following requirements:

- Resistance to ultraviolet light
- Wide temperature flexibility
- Cyclic movement capability (both extension and compression)
- Fuel resistance
- Jet blast resistance

Federal Specifications SS-5-2000, SS-3-1614A and ASTM Specification D 3509 attempt to test for the above performance requirements. However, when it comes to cyclic movement capability, they all fall short. The best cyclic movement test that closely relates to actual field conditions is ASTM C 719. See Table I for a brief comparison of these specifications.

Since there are few federal or ASTM specifications presently written for silicone, Dow Corning developed a test method to verify that silicone sealants can meet the requirements for airfield applications mentioned above.

appeared to be a more accurate depiction of actual field conditions.

The test consists of forming several sealant test joints between two concrete blocks with a dam on top of each block (see Figure 1). The sealant is allowed to cure. The dam is filled with the test fluid (i.e., jet fuel). The fluid is then allowed to dissipate, so it would be in the field. If more than one fluid is to be tested on the same joint, then approximately one week separation each fluid application. At the end of the fluid exposure, these same test joints are then subjected to cyclic testing per the ASTM C 719 specification.

Figure 2. Effect of Fuel Spill on Dow Corning® Silicone Joint Sealant



Specification	Sealant Type	Cyclic Movement Exposure	Compression
SS-5-2000	Cold Applied	5 cycles @ 0°F (-17°C)	None
SS-3-1614A	Hot Applied	5 cycles @ 0°F (-17°C)	None
ASTM D 3509	Hot Applied	5 cycles @ 0°F (-17°C)	None
ASTM C 719	Cold Applied	10 cycles @ -17°F (-26°C)	10 cycles @ 150°F (65°C)

Fluid	Dow Corning® 790 Silicone Joint Sealant	Dow Corning® 795 Silicone Joint Sealant
0% to 10% Ethanol	2 percent	17 to 20 percent
30% to 40% Ethanol	None	None
Hydraulic Fluid	None	None

1. Recess min **1/8" - 1/2"** Below Surface
2. 2 to 1 Ratio
3. Tooling Required



# Silicone Sealing Application

40° F Minimum Pavement Temperatures  
1/8" Minimum Recess  
Requires Tooling





# Silicone Sealant Installed at Joint Intersection





# Silicone Adhesion Test



1. Make a knife cut horizontally across the silicone
2. Make a vertical cut approximately 3 inches long on each side of the joint
3. Hold the piece of silicone firmly and slowly pull at a 90° angle. If adhesion is proper, the silicone will not pull out of the joint, but will eventually tear cohesively

# Compression Seal Installation



- Lubricant-Adhesive shall meet ASTM D2835
- Installation Above 32 F
- Install Sealant in Longitudinal Joint First
- Cut Longitudinal Joint in Center of Each Transverse Joint
- Install Transverse Joint Continuously Across
- Sealant Stretch Should be Less than 4 %
- Recess Sealant 3/16"



# Properly Installing Compression Seal



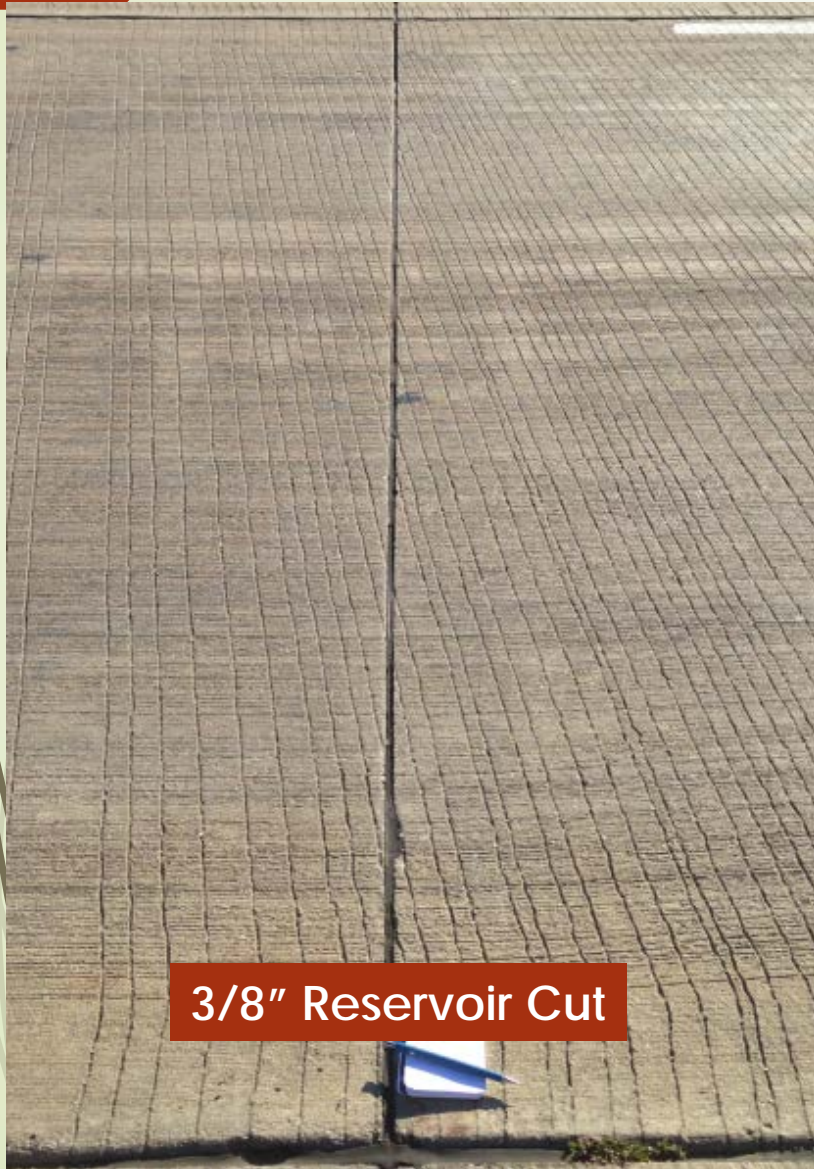


# Compression Seal at Joint Intersection





# Hot Pour Sealants





# Single Saw Cut Sealant Extrusion



# Can We Seal a Joint?

20 Years Old

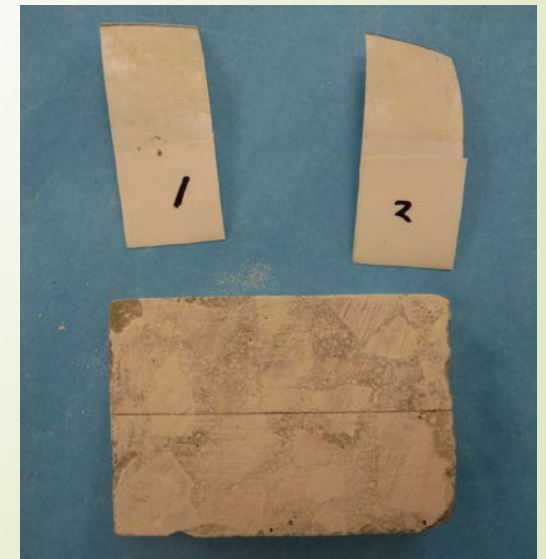
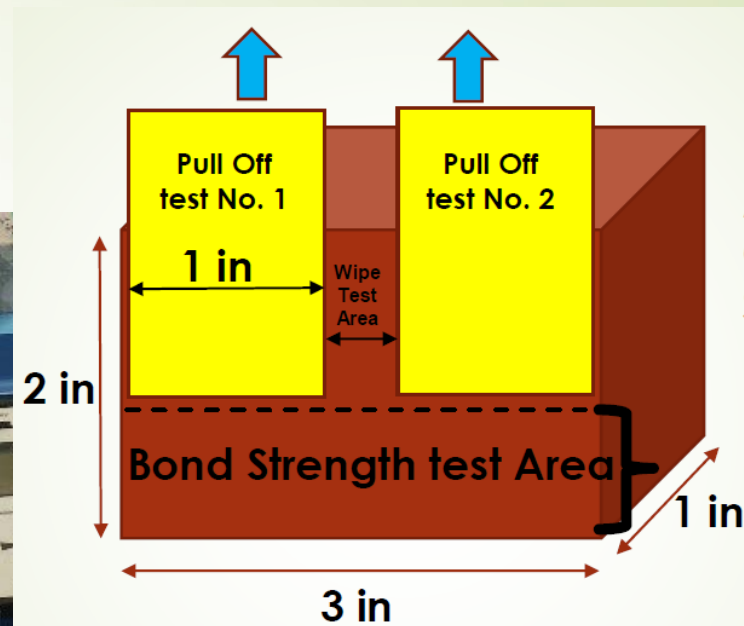
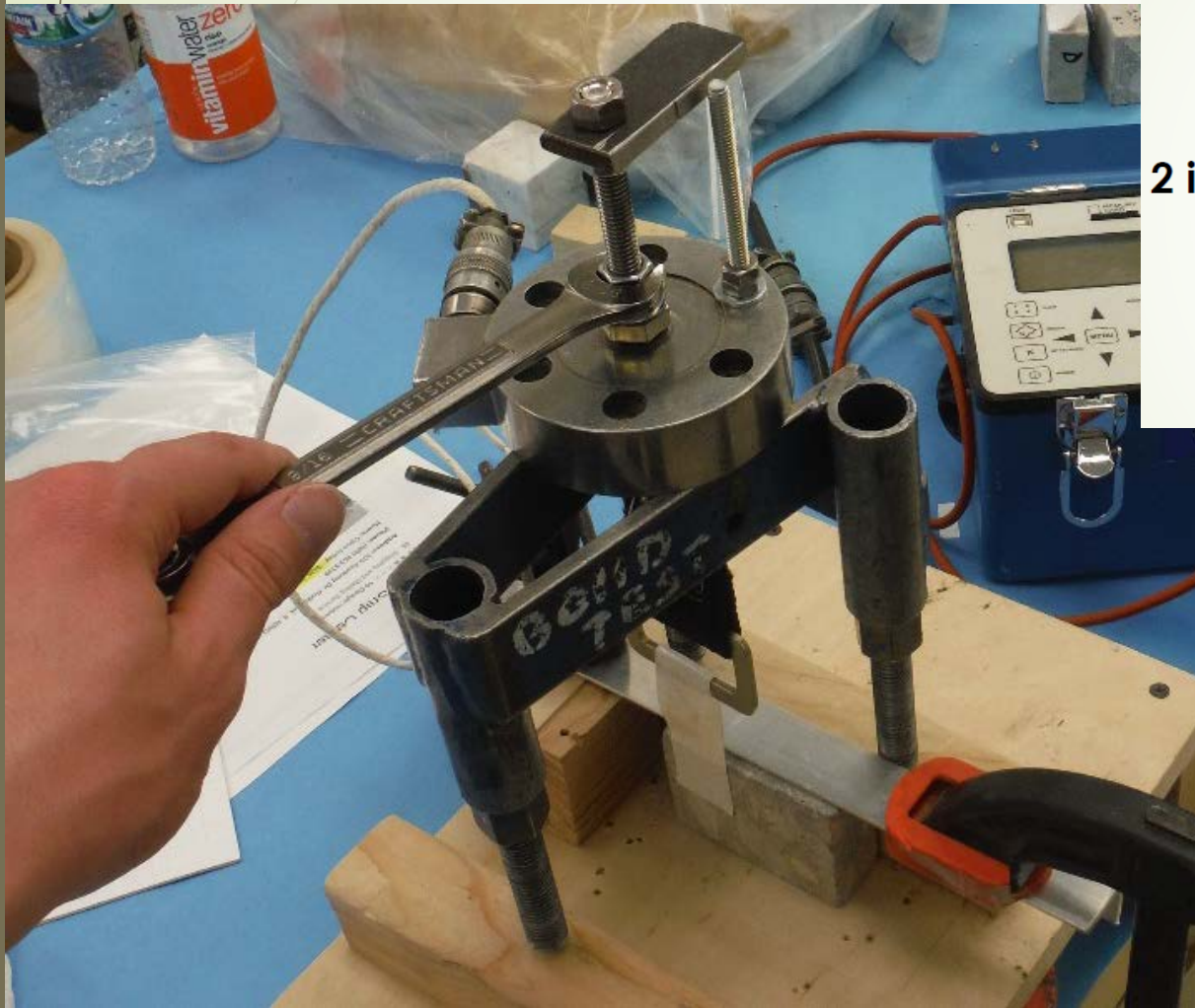


1 Year Old



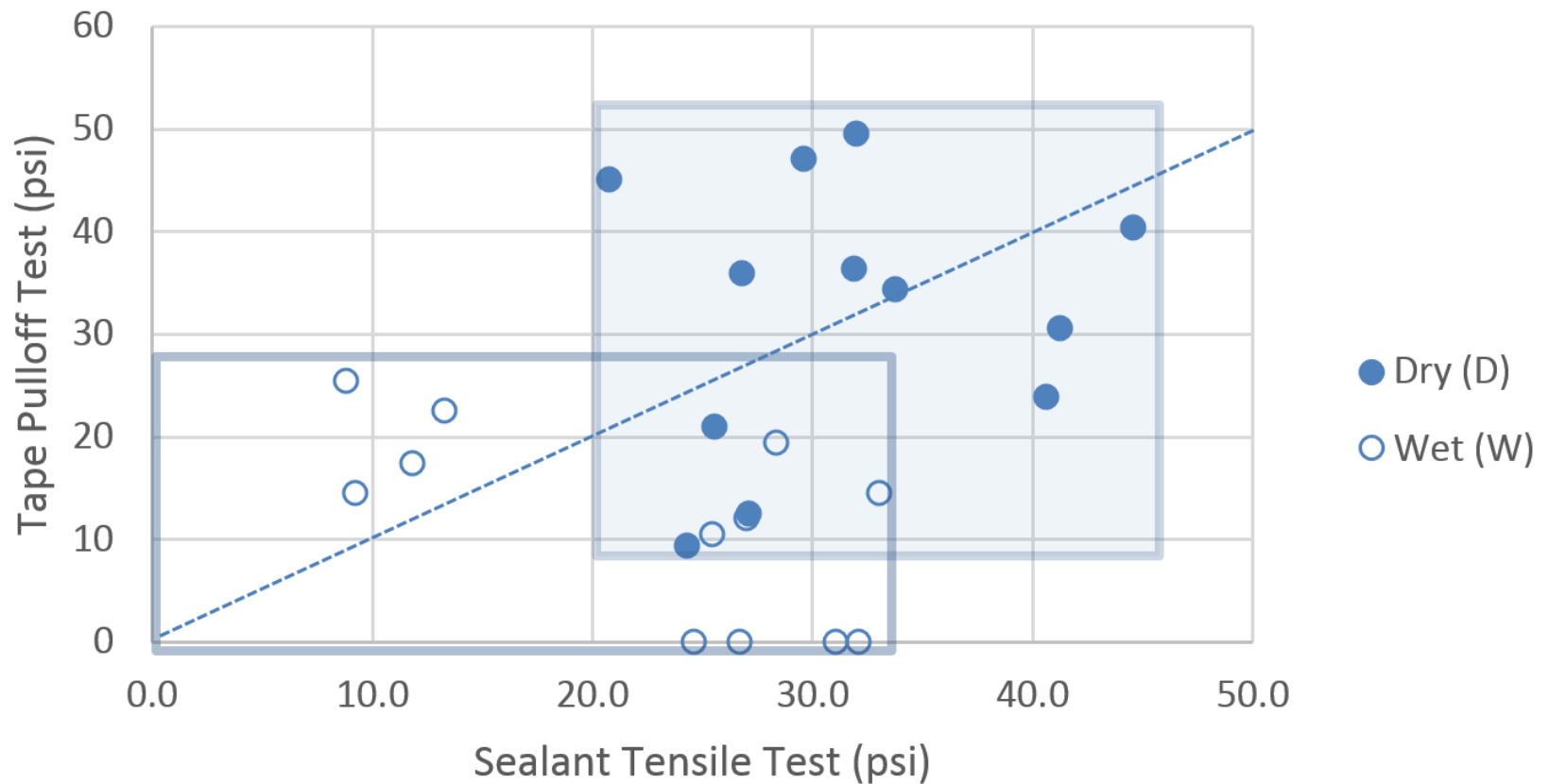


# WJE Pull Off Test



# Comparison of Tape Pull off Test to Tensile Bond Test

Dry v. Wet





# Is Sealant Cost Effective?

## FHWA Sealant Effectiveness Study

### TechBrief

The Concrete Pavement Technology Program (CPTP) is an integrated, national effort to improve the long-term performance and cost-effectiveness of concrete pavements. Managed by the Federal Highway Administration through partnerships with State highway agencies, industry, and academia, CPTP's primary goals are to reduce congestion, improve safety, lower costs, improve performance, and foster innovation. The program was designed to produce user-friendly software, procedures, methods, guidelines, and other tools for use in materials selection, mixture proportioning, and the design, construction, and rehabilitation of concrete pavements.

[www.fhwa.dot.gov/pavement/concrete](http://www.fhwa.dot.gov/pavement/concrete)



U.S. Department of Transportation  
Federal Highway Administration



### Performance of Sealed and Unsealed Concrete Pavement Joints

This TechBrief presents the results of a nationwide study of the effects of transverse joint sealing on performance of jointed plain concrete pavement (JPCP). This study was conducted to assess whether JPCP designs with unsealed transverse joints performed differently from JPCP designs with sealed transverse joints. Distress and deflection data were collected from 117 test sections at 26 experimental joint sealing projects located in 11 states. Performance of the pavement test sections with unsealed joints was compared with the performance of pavement test sections with one or more types of sealed joints.

#### BACKGROUND

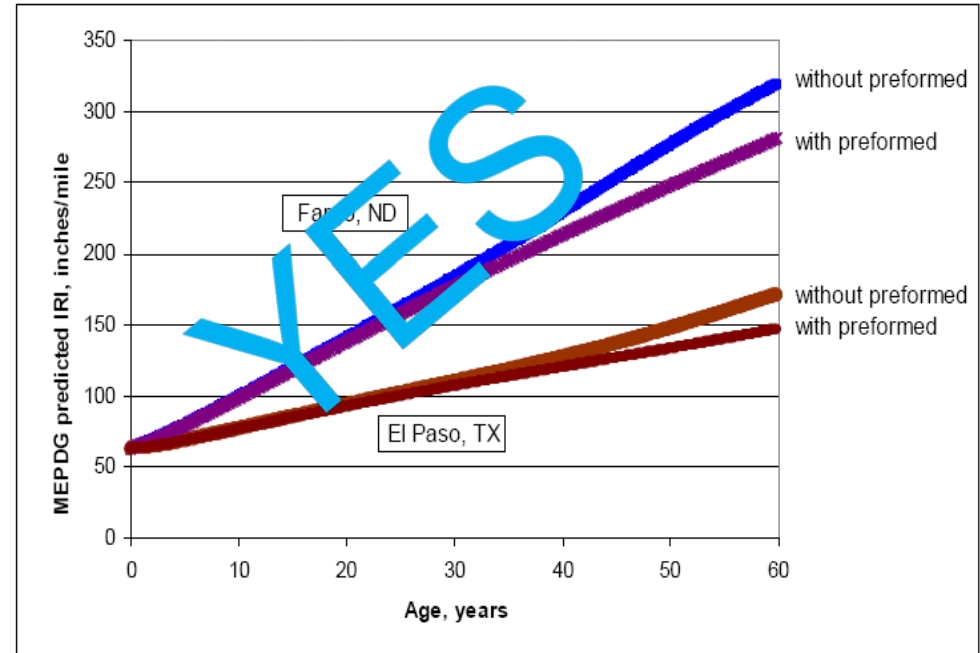
The sealing of transverse contraction joints in JPCP has been standard practice throughout much of the United States for many years. Its widespread use is due to the common belief that sealing joints improves concrete pavement performance, not only by reducing water infiltration into the pavement structure, thereby reducing the occurrence of moisture-related distresses such as scaling and delamination, and by preventing the infiltration of incompressibles (i.e., dirt and gravel) into the joints, thereby reducing the likelihood of pressure-related joint distresses such as joint spalling and blowups.

Transverse joints in jointed concrete pavement (JCP) are typically created by making an initial saw cut to force controlled cracking, followed by a second, wider saw cut to produce a reservoir for the joint sealant material. This traditional approach of sawing and sealing transverse contraction joints is estimated to account for between 2 and 7 percent of the initial construction cost of a JCP. Moreover, these sealed transverse joints require resealing one or more times over the service life of the pavement, leading to additional costs in terms of labor, materials, operations, and lane closures.

Recently, several State departments of transportation (DOTs) have been questioning conventional transverse joint sawing and sealing practices. These agencies contend that the benefits derived from sealing do not offset the costs associated with the placement and continued upkeep of the sealant over the life of the pavement. As a result, they have been experimenting with different sawing and sealing alternatives, for example:

- Narrow unsealed joints, consisting of single saw cuts that are left unsealed.
- Narrow filled joints, consisting of single saw cuts that are filled with sealant that adheres to the sides and bottom of the saw cut.
- Narrow sealed joints, consisting of single saw cuts that contain a narrow backer rod and sealant material.

## AASHTO New Design Guide



# Is Sealant Cost Effective

The Second  
STRATEGIC HIGHWAY RESEARCH PROGRAM

 SHRP 2 REPORT S2-R26-RR-2

## Guidelines for the Preservation of High-Traffic-Volume Roadways

D. PESHIKIN, K. L. SMITH, A. WOLTERS, AND J. KRSTULOVICH  
Applied Pavement Technology, Inc.  
Urbana, Illinois

J. MOULTHROP AND C. ALVARADO  
Petro Consultants, Inc.  
Austin, Texas

TRANSPORTATION RESEARCH BOARD

WASHINGTON, D.C.  
2011  
[www.TRB.org](http://www.TRB.org)

Treatment	Expected Performance	
	Treatment Life (yr)	Pavement Life Extension (yr)
Concrete joint resealing	2–8	5–6
Concrete crack sealing	4–7	NA
Diamond grinding	8–15	NA
Diamond grooving	10–15	NA
Partial-depth concrete patching	5–15	NA
Full-depth concrete patching	5–15	NA
Dowel bar retrofitting	10–15	NA
Ultra-thin bonded wearing course	6–10	NA
Thin HMA overlay	6–10	NA



# Effectiveness---

## Newest Research Findings

QUALIFICATION OF JOINT SEALANT EFFECTIVENESS ON  
JOINTED CONCRETE PAVEMENT PERFORMANCE

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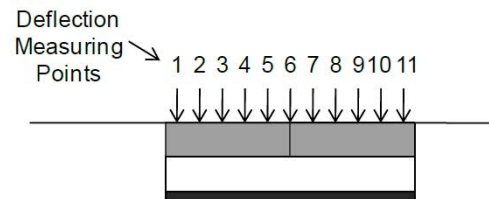
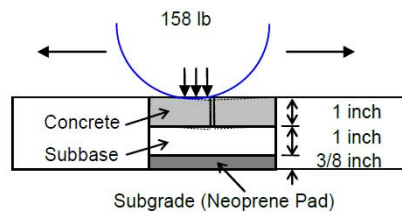
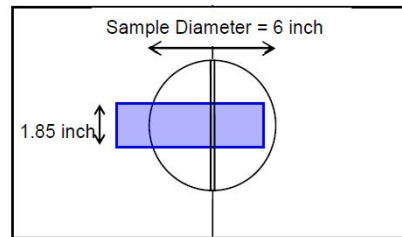
Performed in cooperation with the  
International Grooving and Grinding Association

April 2015  
Revised November 2015

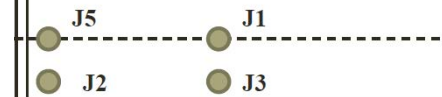
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University System  
College Station, Texas  
77843-3135

A key outcome of this project is advancement of a mechanistic tool for analysis of specific combinations of traffic, climate, base materials, and sealant condition on subbase erosion and pavement performance

# TTI Work



9 FWD Testing.



**Figure D.1** Erosion Test Using Hamburg Wheel-Tracking Device.



# Summary



- Design Joint Sealant System for the Expected Joint Movements
- Select a Joint Sealant Material and Backer Rod Appropriate for the Intended Purpose
- Ensure Proper Cleaning and Preparation—Clean, Dry and Bondable
- Inspect the Work and Verify its Acceptability

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## Seal / No Seal GROUP



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The **Seal/No Seal Group** was formed to respond to the age-old industry question about the value of sealing concrete pavement joints. Its mission is to develop a committed membership that takes responsibility for determining the long-term effectiveness of sealants in concrete pavements.

As cost pressures continue, there is increased interest in eliminating transverse joint sealants as a means of lowering the cost of concrete pavements. However, there is a lack of data in the industry to help guide owners about sealant effectiveness and the long-term impact of using or not using such sealants.



*Shown here is the hot pour sealing of the control joints on the test sections for a project in Joliet, IL. The project involved sealing the*

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# Tech Briefs

Seal No Seal .

## Tech·Brief

### Evaluation of Backer-Rod Absorption

#### Introduction

This study was conducted as a result of concern that backer rod absorption may be a contributing factor in premature joint deterioration. To evaluate this, a limited survey of contractor practices was conducted to determine the types of backer rods in use.

A limited backer rod absorption study was then conducted to determine if they absorbed or retained water.

Although only closed-cell backer rods are intended for use with silanes and hot poured sealants, a small, sealed, closed-cell backer rod found its way into a hybrid backer rod.

The hybrid backer rod, which opened up, caused perimeter leaking. Concrete perimeter leaking was found to absorb water and potentially durability issue.

#### Backer-Rod Absorption Experiment

To evaluate the three backer rods, a simple experiment was performed to assess the absorption characteristics.



Figure 1: Backer rods submerged in water.

The experiment consisted of submerging inch-long specimens of each backer rod into a glass of tap water and removing and weighing the backer rods at periodic intervals. This is used to weigh the sample to an accuracy of 0.005 lbs which is accurate to the weight of a dime or so for 1.5" experiments. Figure 1 is a photo of the samples submerged below the water level.

Seal No Seal .

## Tech·Brief

### Use of Silanes for Sealing Joints in Concrete Pavements

#### Introduction

Traditionally, sealing of transverse and longitudinal joints in concrete pavements has been accomplished through the use of formed-in-place or compression-type sealants installed shortly after pavement construction or during rehabilitation efforts. The common sealant types are hot pour, silicone, and neoprene compression sealants in varying geometric joint designs.

In recent times, concrete has developed regarding joint-associated distress that is evident in some surface states. The distress often begins at a joint and progresses outward as the deterioration increases. Figure 1 is a photo of a parking area with this type of distress in advanced stages. This distress is primarily a function of freeze/thaw damage.

Concern regarding this type of distress has led to the use of concrete sealers to better protect the concrete from ingress of water at the surface and into the joint.




Figure 2: Concrete joint surface showing distress.


#### Concrete Sealers

Concrete sealers have been used in the highway industry since at least the 1980s, mainly as a preventive maintenance treatment on bridge decks.

Sealers are being used increasingly to protect concrete generally and are classified as two types as shown below.

1. **Non-Reactive Sealers**
  - a. **Water-Repellent Sealers**
  - b. **Silanes (CHS)**
  - c. **Siloxane Sealers**
2. **Reactive Sealers**
  - a. **Silicates**
  - b. **Silicates**

Non-Reactive Sealers coat the concrete surface but do not react with the concrete itself. They typically have a life life (10-15 years) and/or bonding of other materials to the concrete. The sealers used in bridge decks are the most durable organic sealers (non-reactive) and are not gone or degraded and are only effective for a few years.

Seal No Seal .

## Tech·Brief

### Joint-Movement Estimator for Designing Transverse Joint Seal Installations

#### Introduction

Sealing of concrete pavements begins every year when full-depth repairs are made to allow for joint cracking. The gap with asphalt, tar, pitch or



Figure 1: Joint-Movement Estimator software interface.

The shape factor is based on the concrete and is a predicted value to depth ratio which will provide the longest sealant performance for formed-in-place sealants.

The desired shape factor is a function of both the material properties and the amount of expected joint opening during movement. The required shape factor then determines the actual joint sealant design for the expected environmental, pavement design, and traffic conditions.

When first implemented, it was necessary to calculate the expected joint opening movement for a particular design installation. This required knowledge regarding the (1) expected change in slab length, (2) slab length, (3) concrete Coefficient of

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## Tech·Brief

### Selecting Backer-Rods for PCCP

#### Introduction

Backer rods are used in PCCP joints to provide the following features:

- Temporary support to allow placement of the sealant into the joint without voiding of the joint which facilitates mechanical bond to the joint face.
- Thickness control of the sealant and subsequently the shape factor and

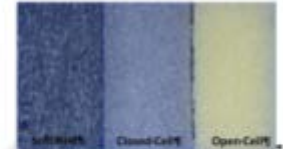


Figure 1: Photo of Backer-Rods (Photo by Seal No Seal).

cellular rod. All four types are chemically inert and compatible with all cold-applied sealants. The term open or closed-cell refers to the structure of the void space within the cross-section of the material. If the void space size

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## Tech·Brief

### Joint-Slap Evaluation and Prevention

#### Introduction

An often overlooked aspect of joint pavement design is the impact of transverse joints on the overall pavement noise level. This aspect is important for the design of new pavements and the rehabilitation of existing pavements. This impact always increases the overall noise level as the noise level experienced by the driver.

As the joints over a transverse joint in a concrete pavement, a "transverse" noise is generated which is commonly referred to as joint slap. This noise is a result of the vibration in the road and is caused by the impact with the pavement joint.

The magnitude of this "transverse" noise is a function of the amount of flexing of the joint, the joint opening width, the sealant level in the joint, and the speed of the vehicle as it passes over the joint.

The increase in overall noise level due to the "transverse" noise is a function of the noise level of the existing pavement structure and the joint spacing in the roadway. The noise the existing pavement structure, the less impact the joint slap has on overall noise level. Therefore, as pavement structures become quieter, the impact



Figure 1: Joint-Slap Evaluation and Prevention software interface.

of the joint slap effect becomes greater. Similarly, the more frequent the transverse joints are encountered either due to speed or joint spacing, the greater the effect on overall noise level.

The American Concrete Pavement Association (ACPA) recently developed a web tool that can be used to estimate the increase in overall noise level for a given joint geometry, existing pavement noise level, and vehicle speed. With this tool, it is now possible to determine the optimal joint configuration for a new pavement design, or the level of a sealed joint in an existing pavement.

The web tool is based on an analysis conducted by Dr. Paul Dumas of Kingwood Heights, Inc. and the joint-slap research conducted at Purdue University. The ACPA web tool is available at <http://www.acpa.org/jointslap/>.

The ACPA web tool, see Figure 1, has two outputs. The first, is an estimate of a single design condition and the second of Fig. 2 is a plot which indicates the impact for various joint



# Questions



# Place Sealant That Only Covers Joint





# Seal Joint Without Cleaning





# Overband Hot Pour Sealant





# What Not to Do

