National Concrete Pavement Technology Center

Tech Center

Rehabilitating and Preserving Joints to Extend Service Life

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Steven L. Tritsch, P.E.
stritsch@iastate.edu

Iowa State University
Institute for Transportation

Presentation Outline

- Why Do We Make and Seal Joints
- Partial-Depth Repairs
- Sealant Considerations
- Sawing Equipment
- Sealant Types
- Major Steps in Joint Sealing
- Troubleshooting
- References

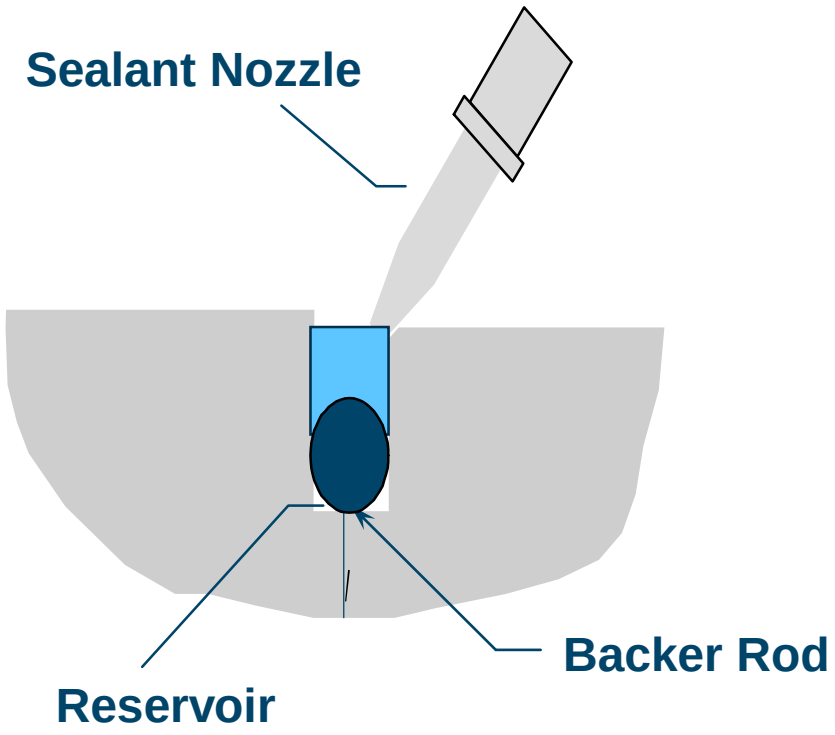
To Control Cracking

Controlled Cracking

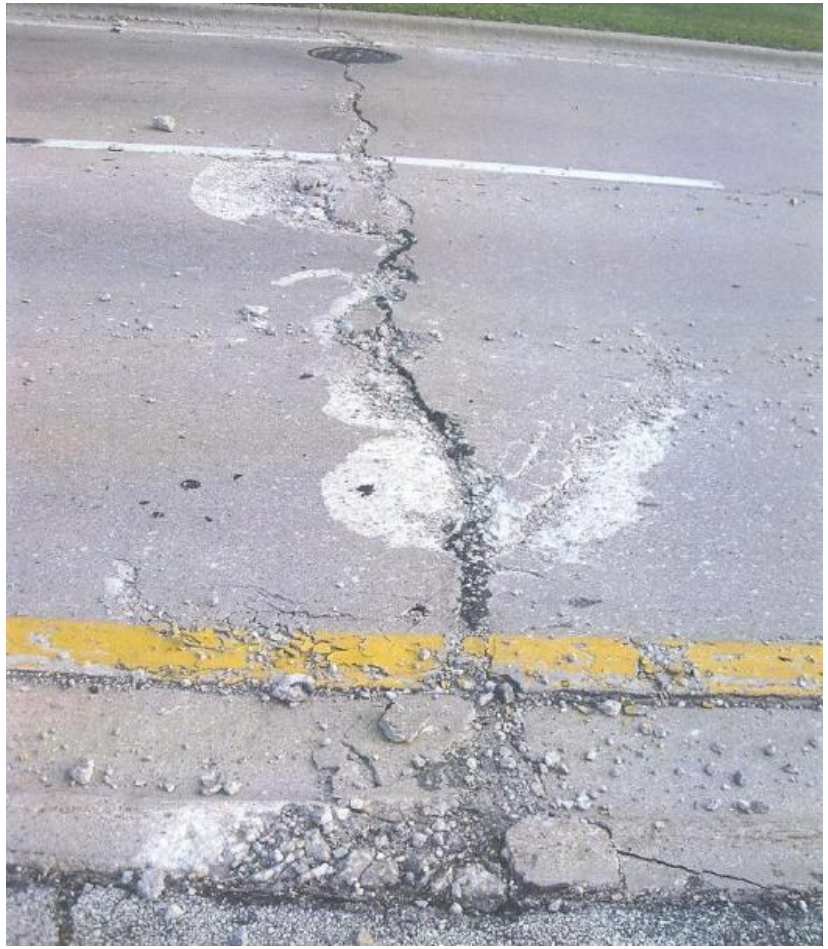
Uncontrolled Cracking

Reasons for Joint Sealing

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



Why Seal Joints and Cracks



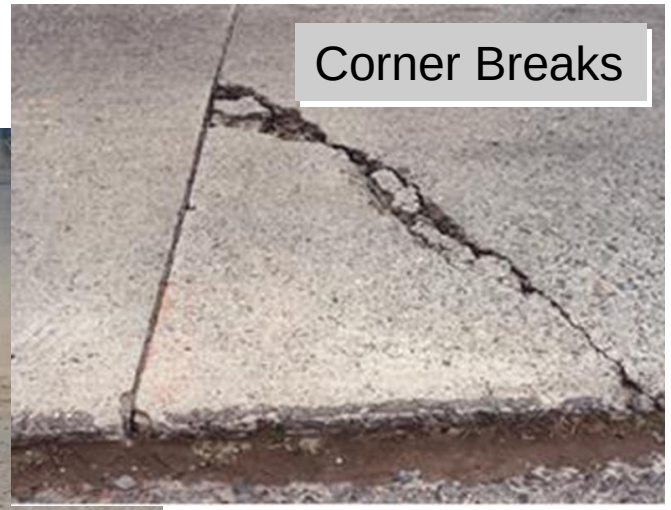
Prevent Incompressibles from Lodging in the Joint — Slab Growth and Blow Ups

PCC Pavement Deterioration

Influence of Moisture Infiltration

Cracks/Joints
+
Moisture Infiltration

Base/Subbase
Softening



The Top Doesn’t Always Tell the Story

Partial-Depth Repairs

Removal and replacement of small, shallow areas of deteriorated PCC at spalled or distressed joints.

- Distress limited to upper 1/3 to 1/2 of slab thickness
- Existing load transfer devices are functional

Benefits

- Restores slab integrity
- Improves ride quality
- Extends the service life
- Restores a well-defined uniform joint sealant reservoir

Good Candidate Projects

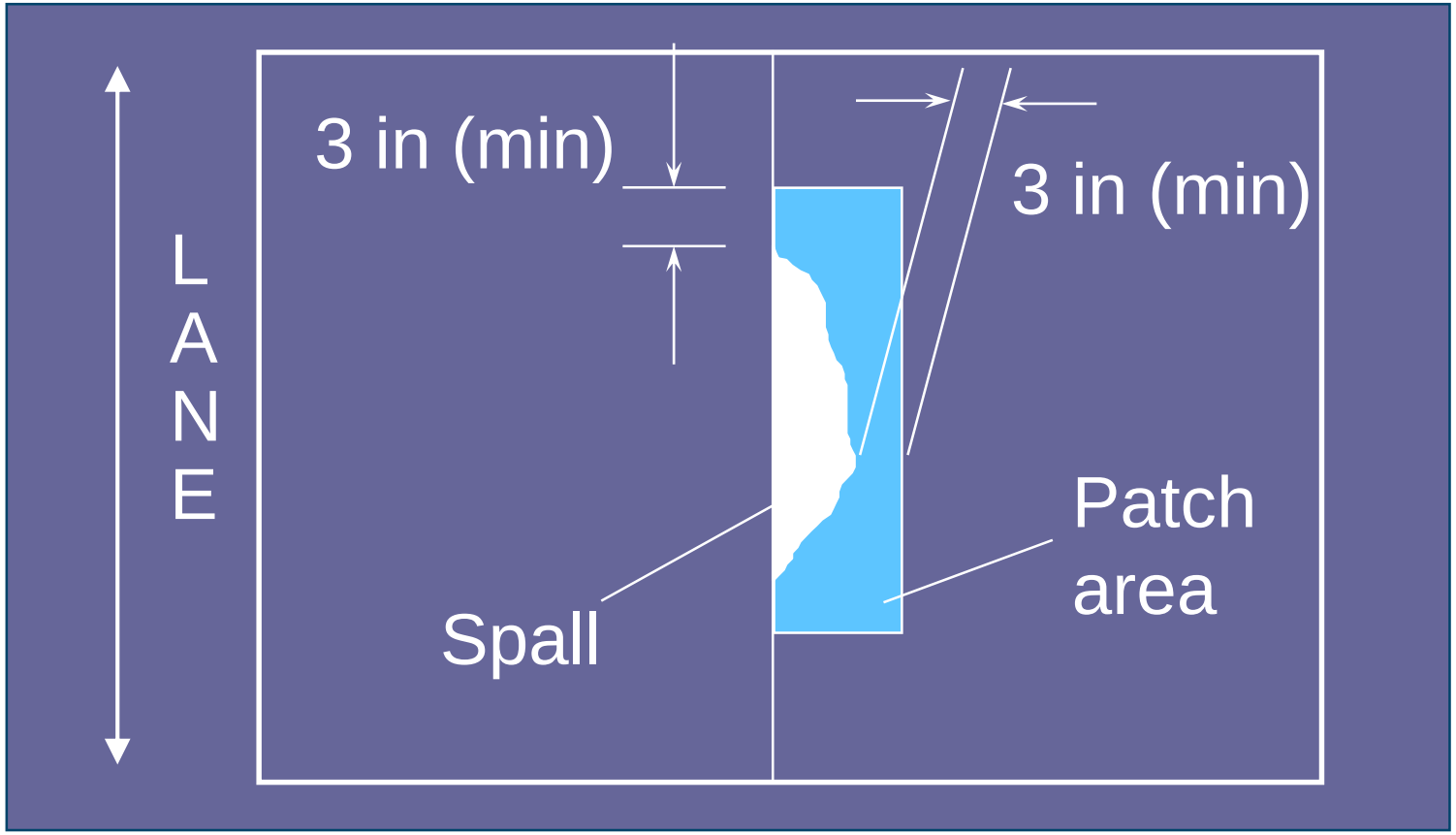
- Spalls caused by:
  - Incompressibles in joints
  - Localized areas of weak material
  - Joint inserts

- Surface deterioration caused by:
  - Reinforcing mesh too close to surface
  - Poor curing or finishing practices

Material Selection Factors

- Allowable lane closure time
- Ambient temperature
- Material and placement Cost
- Material properties (shrinkage, CTE, bond strength)
- Compatibility between repair material and existing pavement
- Size and depth of repair
- Performance capabilities

Repair Dimension Selection



Min. Patch Length 10 in
Min. Patch Width 4 in

Construction Steps

1. Repair dimension selection
2. Concrete removal
3. Repair area preparation
4. Joint preparation
5. Bonding agent application
6. Patch material placement
7. Curing
8. Diamond grinding (optional)
9. Joint resealing

Municipal Projects

Credit: Adam Lust, City of Ankeny

Credit: Jeff Nash, City of West Des Moines

Sealant Performance Depends On

- Design Factor
  - 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

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

Joint Sealing Materials

Material Type	Specs	Description
Polymerized/ Rubberized Asphalt	ASTM D6690, Type I-IV (AASHTO M324)	Thermoplastic I: Mod climates II-III: Most climates IV: Very cold climates
Silicone	ASTM D5893, Type NS or SL	Thermosetting NS: Non-sag SL: Self leveling
Polysulfides, polyurethane	Fed Spec SS-S-200E, type M or H	Thermosetting
Preformed	ASTM D2628	Polychloroprene
Backer Rod	ASTM D5249	For hot- or cold-applied sealants

Joint Sealant Installation

Major Steps in Joint Sealing

Step 01

Saw Joint or Crack Reservoir

Remove Old Sealant (Opt.)

Step 02

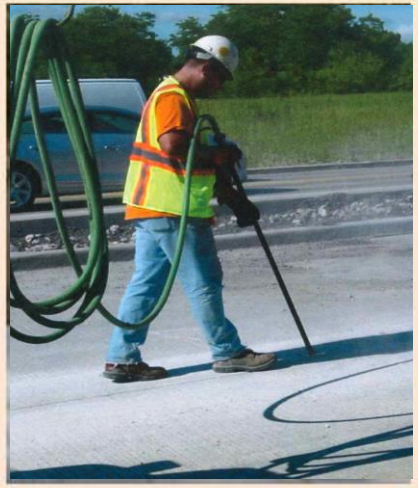
Water Flush Joint or Crack

Step 03

Abrasive Blast Joint or Crack

Step 04

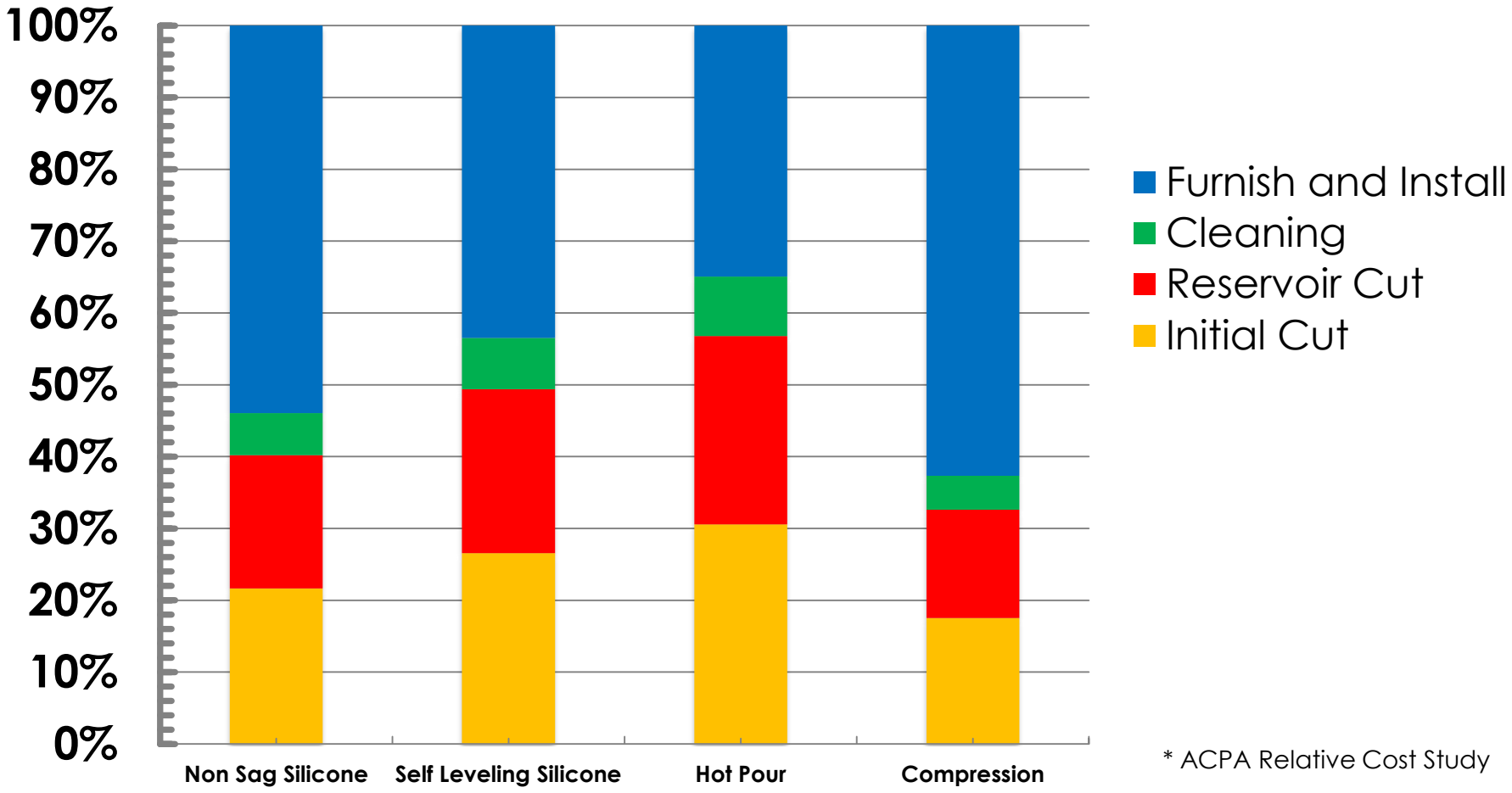
Air Blow Joint or Crack



Step 05

Install Backer Rod (if required) and Sealant or Seal

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



* ACPA Relative Cost Study

Joint Sawing Equipment

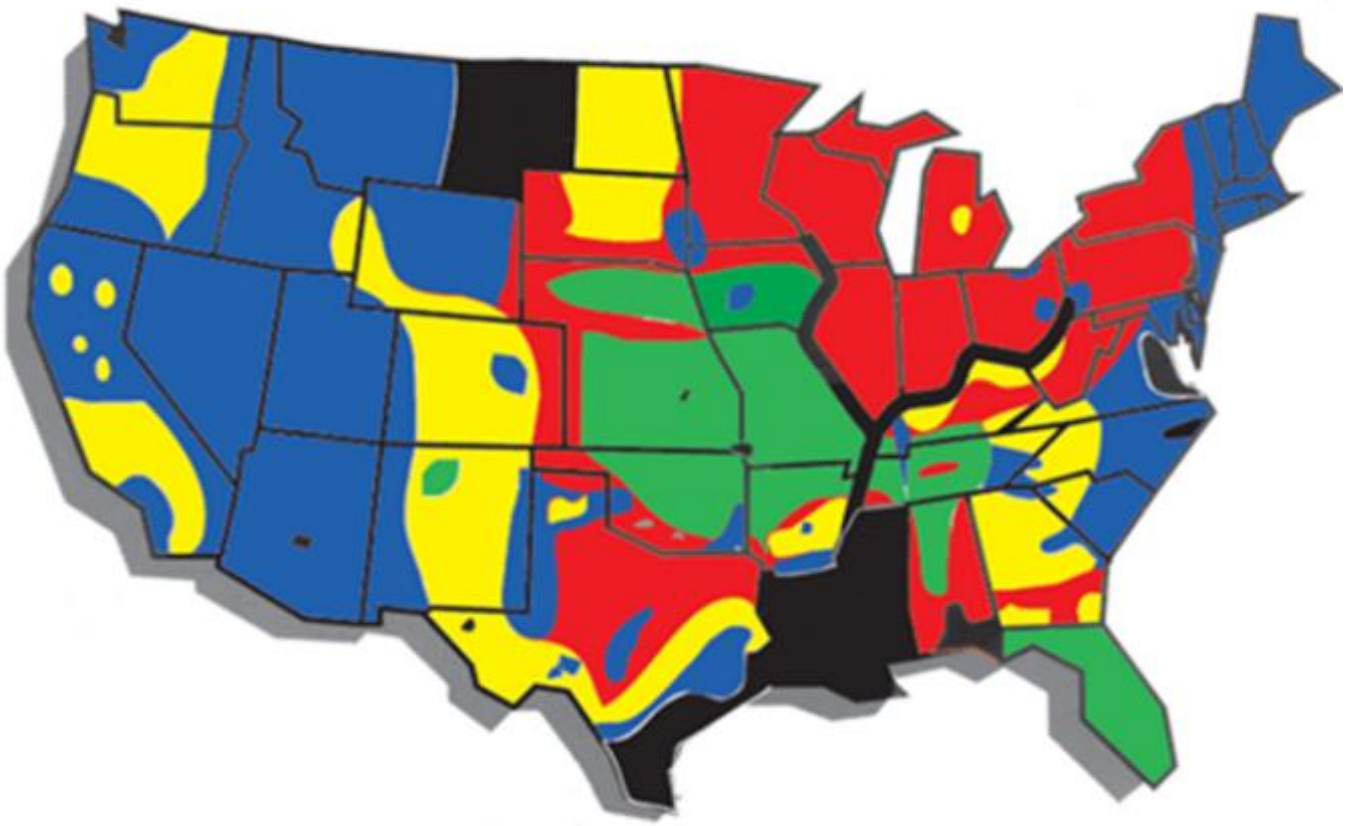
Wet Saws

Early Entry Saws

Dry Saws

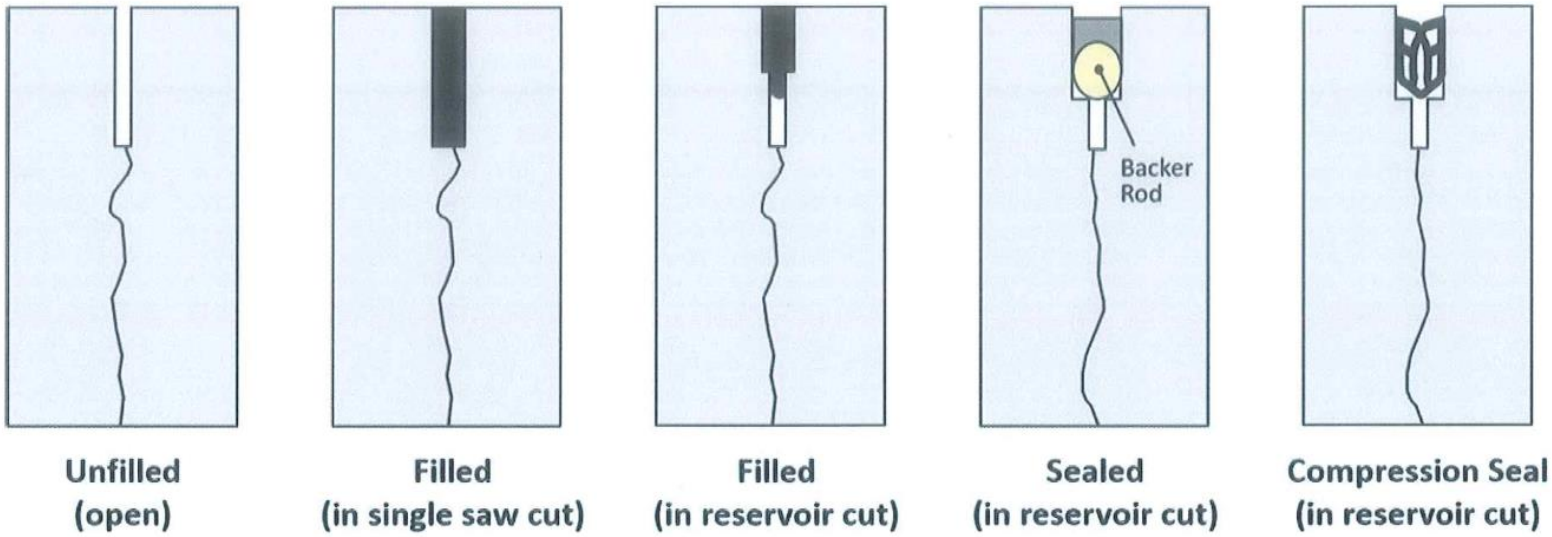
Crack Chaser Saws

Aggregate Hardness: Key Factor for Sawing Operations



Mohs Hardness	Aggregate Used In Concrete Mix
8	**Very Hard Aggregate** (flint, chert)
7	**Hard Aggregate** (quartz, hard gravels)
6	**Medium Hard Aggregate** (medium gravels, granites)
5	**Medium Soft Aggregate** (soft granite, dolomite)
4, 3	**Soft, Abrasive Aggregate** (limestone)

Reservoir Design and Cutting

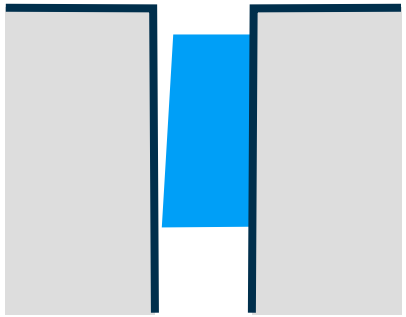


Install Hot-Pour Sealant

- Follow proper heating, safety, and installation procedures
- When installing:
  - Fill the reservoir from the bottom upward
  - Use nozzle that fits into reservoir
  - Pull the wand/nozzle toward you to avoid trapping air pockets
  - Do not dispense sealant until it reaches proper manufacturer-recommended temperatures (300–400 °F)
  - Discard over-heated material and do not reheat material more than recommended by the manufacturer
  - Dispense sealant to create flush-filled condition
  - Use a constant, uniform flow
- Do not open to traffic until sealant cools
- Use blotters or anti-tack aids if opening early

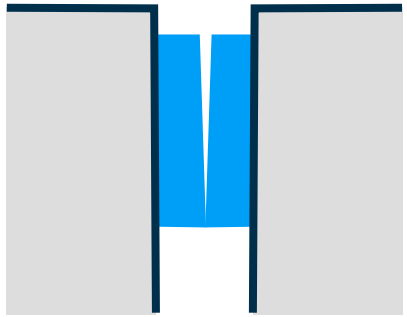
Sealant Performance and Defect Terminology

Adhesion Loss



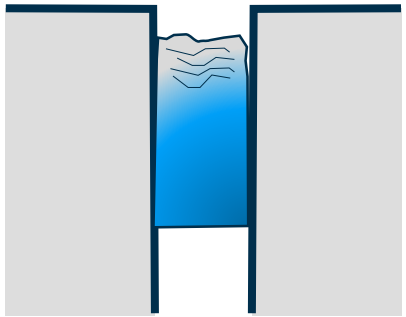
Sealant loses bond to one or both joint reservoir walls

Cohesion Loss



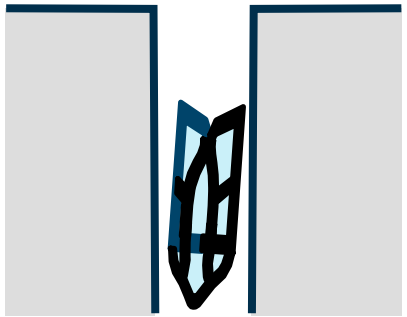
Tearing along the surface and through the depth of sealant

Oxidation/Hardening



Degradation of sealant material as a result of natural aging, long-term exposure to oxygen, ozone, ultra-violet radiation, or the embedment of incompressibles

Compression Set



Seal webs stick together or seal rubber loses ability to rebound and seal loses contact with side walls

The Most Common Distresses

Hot-Pour Sealants	Silicone Sealants	Preformed Compression Seals
• Adhesion loss • Cohesion loss • Bubbling • Hardening • Embedding of incompressibles • Dislodging or missing	• Adhesion loss • Cohesion loss • Sliver spalling • Dislodging or missing	• Compression set • Dislodging or missing • Improper sizing (not a distress but can lead to problems)

Time to Address the Issue

When the Sealant is No Longer Serving its Intended Function

Adhesive Failures

Cohesive Failures

% Damaged or Missing

Clean Isn’t an Option

Technical Bulletin

Joint Reservoir Quality Control Wipe Test

FOREWARD

When properly installed and maintained, joint sealants prolong concrete pavement life by providing important protections. The most critical steps in getting the best value from joint sealing or filling are good reservoir preparation and proper installation of sealant materials. Everyone involved in the joint sealing process must be especially committed to performing thorough joint preparation and cleaning activities to get the best value from any of the available formed-in-place or preformed sealant materials. There is little doubt that poorly designed and/or installed joint sealants will fall short of expectations and will contribute little to pavement performance.

The concrete pavement industry has developed the Wipe Test to provide contractors and inspectors with a new tool for ensuring consistent, high-quality levels of joint preparation and cleaning prior to the installation of sealant materials.

The Wipe Test is intended as a quality control sampling test. It was neither developed with the intention to become a specification requirement, nor developed as a quality assurance or acceptance test. The Wipe Test is a quick, simple way to check the effectiveness of cleaning methods and techniques during field installation work. When performed properly, the test captures the relative amount of concrete dust, dried saw slurry, and other contaminants found on the joint reservoir walls and bottom.

This document describes the Wipe Test, including required equipment, materials, procedures and suggested documentation. ACPA gratefully acknowledges Wiss, Janney, Elstner Associates which was instrumental in developing and validating the method for industry.

TEST METHOD TITLE: ACPA Quality Control Wipe Test

STANDARD TEST REFERENCES:

1. Society for Protective Coatings SP 13/NACE 6, Surface Prep of Concrete (Section 5.4 and 6)
2. ASTM D 5295 -- Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems

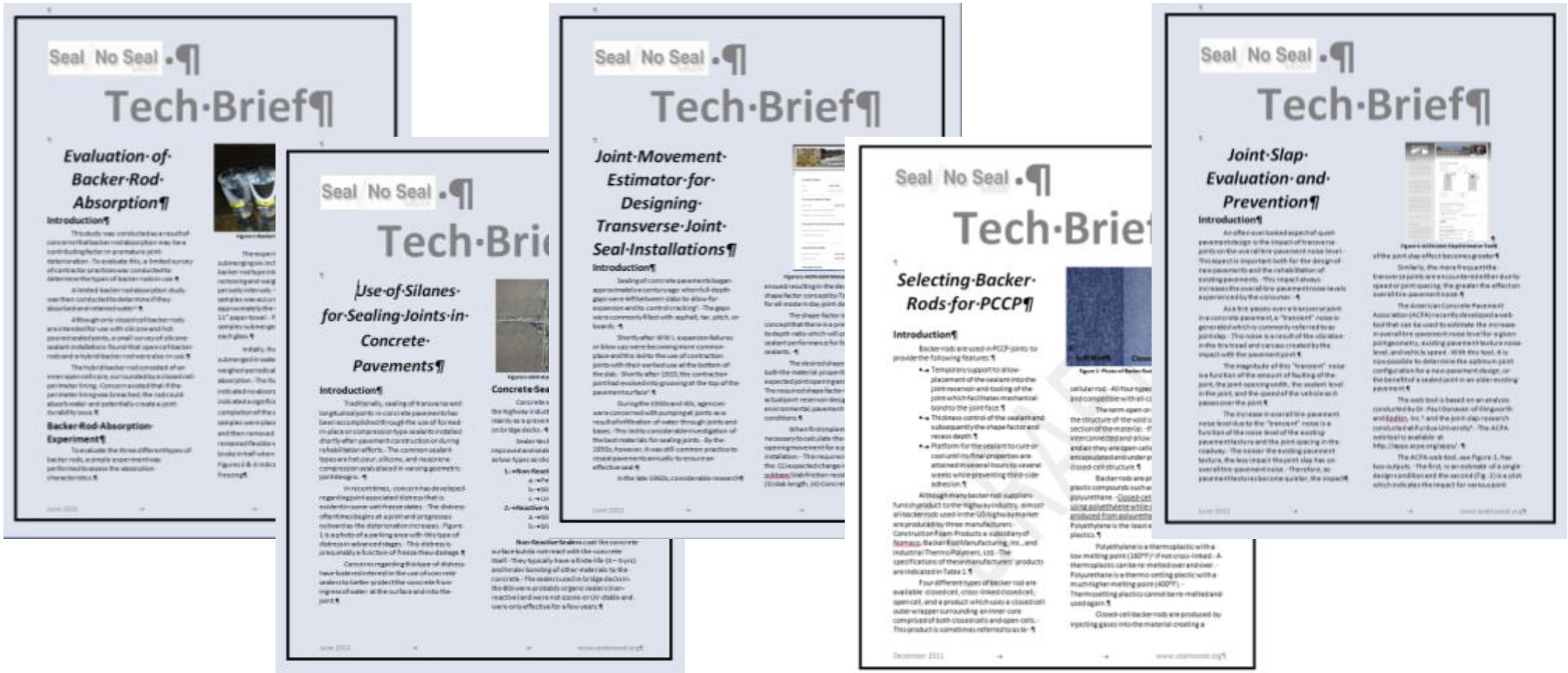
PURPOSE OF TEST:

Quality control measure of the cleanliness of a joint sealant reservoir prior to installation of joint sealant material.

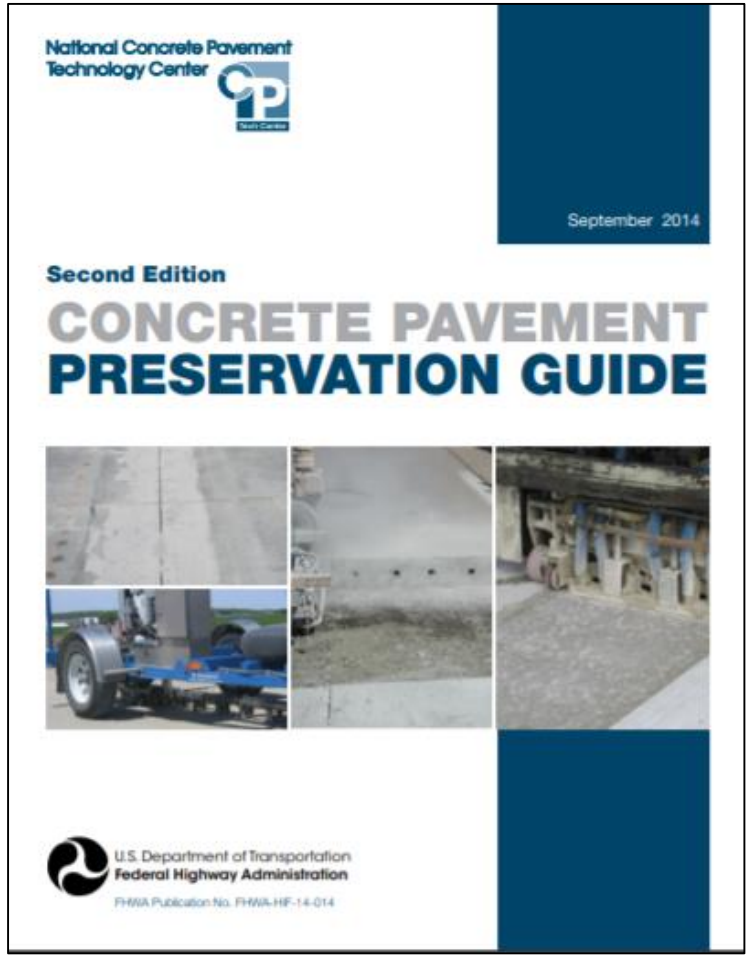
RTU 17.01-2017 Wikipave.org

Tech Briefs

https://www.sealnoseal.org/news.htm



FHWA ,ACPA, CP Tech Center



NHI Contractor Training Courses

Web Based Training at no cost to the participant

- FHWA-NHI-134207A *How to Construct Durable Full-Depth Repairs in Concrete Pavements*
- FHWA-NHI-134207B *How to Construct Durable Partial-Depth Repairs in Concrete Pavements*
- FHWA-NHI-134207C *Proper Diamond Grinding Techniques for Pavement Preservation*
- FHWA-NHI-134207D *Proper Construction Techniques for Dowel Bar Retrofit and Cross-Stitching*
- FHWA-NHI-134207E *Proper Joint Sealing Techniques for Pavement Preservation*

FHWA-NHI-134207B

How to Construct Durable Partial-Depth Repairs in Concrete Pavements

- Introduction to Partial-Depth Repairs
- Types of Partial-Depth Repairs
- Planning and Preparing for Partial-Depth Repairs in the Field
- Identifying and Marking Repair Boundaries
- Options for Concrete Removal
- Preparing the Repair Area after Concrete Removal
- Selecting and Handling Repair Materials
- Installing a Compressible Joint Insert
- Placing Repair Material and Completing the Repair
- Quality Control and Opening to Traffic

FHWA-NHI-134207E

Proper Joint Sealing Techniques for Pavement Preservation

- Introduction to Sealing and Resealing Pavement Joints and Cracks
- Material Types, Standards, and Details
- Equipment Types and Use
- Construction Operations for Joint or Crack Sealing
- Quality Control and Inspection
- Sealant Performance and Troubleshooting

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

Thanks for your time

Convict Road, Louisa County 1914