Crack Treatment Workshop & Instructional Demonstration

National Transportation in Indian Country Conference

Big Sky, Montana
September 18, 2019
Agenda

1:00pm – 3:45pm (2:30-3:00 break)
• Classroom training:
  – Introduction to Crack Treatments
  – Project Selection & Design
  – Materials
  – Equipment & Proper Installation

3:45pm – 4:30pm
• Outdoor Instructional Demonstrations
Introduction to Crack Treatments

- What is a Crack Treatment?
- What is Crack Sealing?
- What is Crack Filling?
- Why do it?
- Benefits
- Use as a Pre-treatment
What is a Crack Treatment?

- Crack Treatments – methods in which cracks are directly treated through sealing or filling operations.
  - Crack Sealing
  - Crack Filling

- Crack Treatments are cost-effective pavement preservation methods that extend pavement life
  - Protect your investments (roads, bridges, parking lots, etc.)
  - Maintains pavement structure
  - Limits future deterioration, prevents potholes
What is Crack Filling & Sealing?

- Crack Sealing:
  - Placement of *specialized treatment materials* (sealant) above or into cracks using unique configurations to *prevent* the intrusion of water and incompressible materials into the crack.

- Crack Filling:
  - Placement of *ordinary treatment materials* into low-moving cracks to *reduce* infiltration of water and to reinforce the adjacent pavement.
<table>
<thead>
<tr>
<th>Crack Sealing</th>
<th>Crack Filling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seals the crack to prevent the intrusion of water and incompressible materials</td>
<td>Fills some of the void in the crack to reduce intrusion of water and incompressible materials</td>
</tr>
<tr>
<td>Specialized treatment materials</td>
<td>Ordinary treatment materials</td>
</tr>
<tr>
<td>Highly-elastic and flexible material</td>
<td>Rigid material or semi-rigid</td>
</tr>
<tr>
<td>Endures vertical &amp; horizontal movement</td>
<td>Can not endure vertical &amp; horizontal movement</td>
</tr>
<tr>
<td>Crack preparation to assure long service life of sealant</td>
<td>Cursory crack preparation</td>
</tr>
<tr>
<td>Sealant placement configuration</td>
<td>Fill crack void, then dust with sand</td>
</tr>
<tr>
<td>Considered semi-permanent</td>
<td>Considered temporary</td>
</tr>
<tr>
<td>Seals routed/working crack (Life average of 5 years. Up to 10 years on new pavements)</td>
<td>Filling not recommended for moving cracks, unable to accommodate movement</td>
</tr>
<tr>
<td>Seals overbanded/non-working crack (Life approximately 2 to 5 years)</td>
<td>Fills non-working crack (Life approximately a few months up to 1 year)</td>
</tr>
<tr>
<td>Modification to perform in a wide variety of climatic temperatures</td>
<td>More susceptible to environmental conditions</td>
</tr>
</tbody>
</table>
## Sealing vs. Filling

<table>
<thead>
<tr>
<th>Crack Sealing Materials</th>
<th>Crack Filling Materials</th>
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<tbody>
<tr>
<td>Asphalt rubber (ASTM D 5078 or State Specifications)</td>
<td>Asphalt cement (Paving Grade or Roofing Grade)</td>
</tr>
<tr>
<td>Rubberized asphalt (ASTM D 6690 type 1, 2 &amp; 3 or State Specification)</td>
<td>Asphalt cutback (MC-30, 70 and 250)</td>
</tr>
<tr>
<td>Low-modulus rubberized asphalt (ASTM D 6690 type 4 or State Specifications)</td>
<td>Asphalt emulsion (SS-1, SS-1h, CSS-1, and CSS-1h)</td>
</tr>
<tr>
<td>Fiberized asphalt</td>
<td>Fiberized asphalt</td>
</tr>
<tr>
<td>Mineral-filled (stone, lime, flyash dust) asphalt</td>
<td>Mineral-filled (stone, lime, flyash dust) asphalt</td>
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<tr>
<td>Sand-asphalt mixes</td>
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Sealing vs. Filling

Crack Sealing

Crack Filling
Why Crack Seal?

“Crack Sealing is the single most cost effective preventive maintenance tool available” ~ FHWA

- Protect your investments (roads, bridges, parking lots, etc.)
- Maintains pavement structure
- Limits future deterioration, prevents potholes
Why Crack Seal?

Slow deterioration and extend pavement service life up to 5 years. Crack treatment is the lowest cost preservation treatment, significantly less than other treatments and provides the most benefit for money spent.
Benefits

- Less money spent to maintain pavement
- Less time wasted in traffic because a road is closed due to more extensive maintenance
- Decreased exposure of highway workers to traffic
- Smoother ride
- Less money you spend repairing your vehicle

Urban road decay costs average drivers up to $377 each year
Crack Sealing as a Pre-Treatment

• Crack Treatments are commonly used as a pre-treatment in conjunction with surface treatments

• Sealing prior to surface treatments enhances the treatment and further extends the pavement life.⁹
NCAT Preservation Study

- National Center for Asphalt Technology, Auburn University
- Lee Road 159, AL
- www.pavetrack.com
- 3-year Preservation Study
- 25 Treatments (2012-2015)
- Crack sealing reduced development of interconnected cracking, and reduced subgrade moisture levels
- Crack Sealing as pretreatment improved surface treatment results by reducing cracking through chip seals and microsurfacing
Crack Sealing Effects

Summary Over the 2 Year Evaluation

- **Crack Sealing alone**
  - Reduced cracking by 75% compared to no treatment

- **Crack Sealing as Chip Seal Pretreatment**
  - Reduced cracking by 100% compared to no pretreatment

- **Crack Sealing as Microsurfacing Pretreatment**
  - Reduced cracking by 45% compared to no pretreatment
Preservation Summary

- Crack sealing appears to be beneficial in all cases
- Preservation treatments reduce subgrade moisture
- Objective life extending benefit curves expected
- Expect extension of project in 2015 research cycle
- “Final” results presented at 2015 Track Conference
Module 2

Project Selection & Design Construction

- Crack Movement
- Low Moving and High Moving Cracks
- Crack Growth
- Crack Formation and Types
- Pavement Condition
- Crack Density
- Crack Width
- Trigger point to justify crack treatment
- When is pavement too far gone for crack treatment?
- Seasonal and Environmental Factors
- Application Configuration
- Reservoir Design Dimensions
Crack Movement

- **Horizontal Thermal Movement**
  - Temperature changes
  - Pavements contract during lower winter temperatures, opening cracks in the pavements
  - Pavements expand during higher summer temperatures, closing cracks in the pavements

- **Vertical Movement**
  - Up and down movement
  - Caused by traffic loads

Cracks can open up to 100% of original width as the pavement temperature changes from summer to winter extremes.

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<td>Seasonal</td>
<td>0 - 25 mm</td>
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</table>
Low Moving Cracks

- Defined as annual movement less than 1/8” (3 mm) per year
- Types are typically:
  - Fatigue (alligator)
  - Block
- Low moving cracks grow average of 1mm annually
High Moving Cracks

• Defined as annual movement greater than or equal to 1/8” (3mm)

• High Moving Cracks:
  • Transverse are always moving
  • Other moving cracks:
    • Reflective
    • Thermal
    • Longitudinal
    • Edge

• May move up to 1” each year
  • Can open up to 100% of original width as the pavement temperature changes from summer to winter extremes
Crack Growth

- Cracks tend to widen or grow over time
  - Asphalt shrinkage with age
  - Thermal movement
  - Debris ravels crack face
- Proper crack sealing will delay and prevent further deterioration and growth of the crack
Crack Formation & Types

- Cracks occur when the AC is no longer flexible enough to resist weather/traffic
  - Traffic loadings
  - Seasonal temperature changes

- Asphalt concrete is most flexible and resistant to cracking at construction
Transverse cracks form perpendicular to the pavement lane

- Thermal
- Reflective (Reflection)

- Typically caused by environmental factors and by reflection of underlying joints

- Often experience concentrated and extreme movement (further spaced the more movement – Ex: 50’ vs 30”)

- Crack Sealing (and routing when appropriate) is recommended to accommodate the expected crack movement
Longitudinal

- Longitudinal cracks run parallel to the pavement lane
  - Construction Joint
  - Thermal/Reflective
  - Wheel path

- Typically caused by construction of pavement joint, thermal conditions, and traffic loading

- Crack Sealing (and routing when appropriate) is recommended to prevent intrusion of moisture and debris.
Block

• Block cracks typically form in older pavement
  • Hardening of asphalt
  • Thermal effects/shrinkage of asphalt during cold weather
  • Form in traffic and non-traffic areas

• Effectively treated by crack sealing\textsuperscript{16}
Edge cracks typically form due to:

- Lack of lateral support
- Settlement of underlying material
- Weak base
- Heavy traffic along edge

Prevent intrusion of run-off water and debris by crack sealing
Fatigue

• Fatigue cracks are also known as “alligator” cracks
• Indication of structural failure
• Typically occurs later in a pavement’s life due to high traffic loads
• Crack seal or fill cracks larger than 1/8” (3mm) as a pre-treatment to other surface treatments
Pavement Condition

- **Good**: Crack Sealing increases life expectancy
- **Fair**: Crack Sealing increases life expectancy
- **Poor**: Crack Sealing increases life expectancy; however, all variables of the pavement should be evaluated to determine the appropriate treatment
**Crack Density**

Greater than 20% Crack Density

Less than 20% Crack Density

*Crack density can be used as a general guideline to determine whether or not routing is appropriate. Dependent upon other pavement variables, routing may or may not be appropriate outside of these guidelines.*
<table>
<thead>
<tr>
<th>Crack to Large</th>
<th>Crack Width</th>
<th>Crack Density Less than 20%</th>
<th>Crack Density Greater than 20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hairline to Large</td>
<td>≤ 1/8” (3mm) – 1 ½” (38mm)</td>
<td>Rout &amp; Seal</td>
<td>Seal Rout to clean, if applicable</td>
</tr>
<tr>
<td>Wide</td>
<td>&gt;1 ½” (38mm)</td>
<td></td>
<td>Seal with Mastic</td>
</tr>
</tbody>
</table>

Rout and Seal cracks up to 1 ½” (38mm) wide

Use Mastics to seal wide cracks
When to Crack Seal?

Pavement Preservation is Cost Effective

Spending $1 on pavement preservation before this point . . . .

. . . eliminates or delays spending $6 to $14 on rehabilitation or reconstruction here.

CRAFCO INC
PRESERVATION PRODUCTS
Pavements Too Far Gone for Crack Treatment

- Extensive fatigue cracking
- Structural failure of underlying pavement base
- PCI
  - Very Poor
  - Failed

Pavement Condition Index Scale

- Excellent 85 - 100
- Very Good 70 - 84
- Good 55 - 69
- Fair 40 - 54
- Poor 25 - 39
- Very Poor 10 - 24
- Failed 0 - 9
Seasonal & Environmental Factors

Crack Sealing can be accomplished in all 4 seasons:

• Summer is typical/customary
• Spring & Fall are optimal
• Winter crack sealing can be done with proper care and if conditions are appropriate
Seasonal & Environmental Factors

- Winter is a good alternate
- Performed in virtually any outside air temperature
- Need dry crack warmed to 40°F
- Hot Air Lance
- Extend your preservation season! Crack seal when no other treatments can be performed
Winter Crack Sealing

- Clean, dry cracks and proper temperature are the keys to effective crack sealing
- Having a dry road is even more important than air or pavement temperature
- When sealing in the winter, choose a softer, more flexible sealant
- Apply sealants at the upper-end of their recommended application temperature range.
- Ensure that your equipment is ready to work in the cold
- Keep the sealant narrow and tight to the pavement to minimize exposure and damage from traffic and snow plows
Seasonal & Environmental Factors

- Work force availability
- Traffic conditions
- Conjunction with other projects
Placement Configurations

• Proper installation is a must! ¹

• **Sealant shape and reservoir configurations** influence performance and are the primary design considerations! ¹

• Maximize cost effectiveness by selecting a quality sealant and completing a quality application.
What are Placement Configurations?

4 Categories of sealant placement configuration for crack sealing:

- Flush Fill
- Overband
- Reservoir
- Combination
Flush Fill Configuration

Flush Fill

• Sealant placed into crack, flush with the pavement

• Any excess is struck off
Overband Configuration

Overband Configurations

- Squeegeed sealant overband (Figure B)
- Capped overband w/ sealing disc (Figure C)
Appropriate Overband Configuration using a Squeegee
Reservoir Configurations

- Standard Flush
- Deep Flush
- Shallow Flush
Combination Configurations

- Designed Reservoir
- Material placed into and over the reservoir
- Material shaped into an overband with squeegee or overband created by use of a sealing disc
- Overband centered over crack reservoir
Appropriate Combination Configuration
Reservoir Design Dimensions

- **Cold Climate**
  - Simple Band-Aid: 44 months
  - Standard Reservoir-And-Flush: 70 months
  - Shallow Recessed Band-Aid: 92.5 months
  - Standard Recessed Band-Aid: 94.5 months

- **Moderate Climate**
Questions?
Knowledge Check
Cracks that move less than _______ per year are considered to be “low moving” cracks

A. 1/32”
B. 1/16”
C. 1/8”
D. 1/4”
Pavements with a crack density less than ___% are recommended for routing where appropriate

A. 15%
B. 20%
C. 25%
D. 50%
Which of the following conditions are ideal for performing crack sealing?

A. When air temperatures are high and high moving cracks are all the way closed
B. When air temperatures are low and high moving cracks are all the way open
C. When air temperatures are moderate and high moving cracks are neither open nor closed
D. When it is raining
Which of the following is true of routing in a cold weather climate?

A. A cutter designed for cold weather climates must be used
B. Routing cannot be performed when the pavement temperature is less than 50º F (10º C)
C. The crack may require a wide, shallow reservoir
D. All of the above
A reservoir should never be greater than _____ inches wide

A. 1/2"
B. 1"
C. 1 ½"
D. 2"
Under what circumstance should a crack sealing mastic be used?

A. When the air temperature is below 40°F
B. When the crack is greater than 1 ½” wide
C. When an overband configuration is being placed
D. When high temperature stability is desired
A high moving crack is defined as having annual movement of ______

A. Less than 3/8” (9.5mm) per year
B. More than 3/8” (9.5mm) per year
C. Less than 1/8” (3mm) per year
D. More than 1/8” (3mm) per year
It is recommended that the pavement temperature be at least ____ °F/C when crack sealing. In colder climates or during winter crack sealing, this can often be achieved by using a hot air lance to heat the crack.

A. 45 °F - (7 °C)
B. 40 °F - (4 °C)
C. 50 °F - (10 °C)
D. 35 °F - (2 °C)
Name that Crack!

A. Longitudinal
B. Fatigue
C. Block
D. Edge
E. Transverse
Name that Crack!

A. Longitudinal
B. Fatigue
C. Block
D. Edge
E. Transverse
Name that Crack!

A. Longitudinal
B. Fatigue
C. Block
D. Edge
E. Transverse
Under which of the following circumstances is crack sealing not recommended?

A. Cracks cover 80-100% of the pavement
B. Transverse cracks are less than 30” apart
C. Cracks are fatigue cracks
D. All of the above
Which of the following cracks is likely to experience the highest amount of movement?

A. Transverse cracks spaces 50’ apart on average
B. Transverse cracks spaced 5’ apart on average
C. Longitudinal cracks
D. Fatigue cracks
Module 3
Materials

Analyze factors that can influence sealant selection and performance.

• Project Specifications
• Sealant Properties
• Climate
• Pavement Conditions
• Installation Configuration
Project Specifications

➢ ASTM = American Society for Testing and Materials
➢ AASHTO = American Association of State Highway Transportation Officials
➢ Agency, State, and Local Specifications
➢ Manufacturer Specifications.
➢ Sealant specification are not exclusive to ASTM or AASHTO criteria.
Common Sealant Specifications

ASTM D6690 or AASHTO M324 Standards:

- Type I material – (Old D1190)
- Type II material – (Old D3405)
- Type III material – (Old Fed-SS-1401)
- Type IV material – (Previous Low Modulus)

Low Temperature
- Specify
  -34, -40 areas  D6690 Type IV
  -22, -28 areas  D6690 Type II,III
  -16 areas      D6690 Type I
  -10 areas      State, local specs
Factors Influencing Sealant Selection

Crack Sealant is subjected to a variety of stresses:

- Horizontal expansion and contraction
- Vertical movement from traffic loads
- Exposure to water from rain and snow
- Aging environmental effects
- Abrasion (traffic, street sweeping, snowplows)
- Temperature extremes between seasons

Effective performance calls for sealant properties that will permit functionality under these stresses.
In order to achieve the properties needed to withstand these stresses, the asphalt must be modified/engineered with polymer, rubber, or other materials which make it a specialized material, designed to prevent the infiltration of water and no-compressible materials in pavement.
These general property requirements can be separated into nine specific characteristics which are important for crack sealants as follows:

1. Adhesion
2. High Temperature Stability
3. Low Temperature Flexibility/Elongation
4. Elasticity
5. Viscosity/Application Consistency
6. Aging Resistance
7. Curing
8. Pot Life
9. Compatibility with Asphalt Concrete

Properties 1-5 are the most common to be found in a crack treatment specification (spec).
Adhesion

Bond Test

- Evaluates the ability of the material to remain adhered to concrete test block when extended multiple times.
- Temperature, # of cycles, block conditions, specimen size, and extension % can vary with the specification and grade of tested material.
- Failure shows as adhesive or cohesive separations when extended.
**Adhesion**

**Tensile Adhesion**

This test measures the amount of elongation a sealant can withstand when cast between two concrete test blocks (73° F).

Higher results indicate greater elongation capabilities of the sealant.
Adhesive Failure

Adhesive failures occur when the sealant remains intact but pulls away from the pavement/walls of the crack.

Cohesive Failure

Cohesive failure occurs when the sealant remains adhered to the pavement but the sealant itself cracks open.
Softening Point

 Indicates the temperature at which the material changes from a solid to viscous liquid. The higher the softening point, the more resistant to tracking the material is.

 Materials that meet 176 °F minimum, are best for reservoir applications.

 Overbands require higher minimum softening temps. Best materials can be heated to 45 °F above pavement before softening.
Tracking

Selecting sealant with the appropriate high temperature stability (softening point) will help prevent tracking.
Cone Penetration

- Indication of material hardness or stiffness at a specified temperature (77°F is standard).
- Measures the amount of indentation of a specified cone with a specific weight (150 grams is standard) for a specific time (5 seconds is standard).
- Higher penetration indicates softer material.
Sealant Properties in Low Temperatures

Ductility - Measures the amount of extension a material will take at a specific temperature and rate of extension.

Sealant unable to elongate becomes brittle and fails
Flexibility

**Flexibility Test**

- Often called the bend or fracture test
- Indicates the ability of an 1/8” x 1”x4” specimen to be bent around a mandrel at specific temperatures without cracking
- Indicates the temperature at which sealant stiffens and loses flexibility
Cracking

Selecting sealant with the appropriate low temperature stability/flexibility is important to prevent cracking (cohesive failure)
Elasticity

- Higher resilience = higher elastic rebound and strength

- Lower resilience = less elastic rebound and resistant to elongation

- Higher resilient sealants are able to better prevent debris, rocks etc. from embedding into the sealant.
- The higher the resilience, the lower the adhesive properties.
Viscosity

- <1500 cp = Very flowable, very self leveling
- 1500 - 4000 cp = Self leveling
- 4,000 - 10,000 cp = Moderate high
- 10,000cp - 15,000 cp = High (Asphalt Rubber, High Fiber materials)
Viscosity

Sinkers
Factors Influencing Sealant Selection

Climate

- Location High temperatures
- Location Low temperatures
- Installation time of the year
- LTPPBind tool
Climate Considerations

- Sealant is subjected to the extreme high and low temperatures
  - Warmer climates require material stiffness to resist flow and tracking.
  - Cooler climates require a softer material for flexibility to allow pavement movement without sealant cracking-debonding.

Sealant material performance is controlled by the relationships and interactions of:

- low temperature
- high temperature
- adhesive and elastic properties over the entire range of temperatures and strains experienced.
Factors Influencing Sealant Selection

Pavement Conditions

- Pavement Type – Asphalt, Concrete or Composite
- Crack Type: Longitudinal, Transverse, Reflection, etc
- Crack Spacing/Density
- Future maintenance-overlays, surface treatments
- Traffic: speed, loads, volume, parking lot, foot, snow plows
- Crack width
- Slopes / super elevation
Factors Influencing Sealant Selection

- Horizontal Thermal Movement
  - Temperature changes
  - Pavements contract during lower winter temperatures, opening cracks in the pavements
  - Pavements expand during higher summer temperatures, closing cracks in the pavements

- Vertical Movement
  - Up and down movement
  - Caused by traffic loads

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Cracks can open up to 100% of original width as the pavement temperature changes from summer to winter extremes.
Factors Influencing Sealant Selection

Installation/Construction

- Melter Type
- Cleaning Methods
- Installation Configuration
- Contractor Experience
- Traffic
So How Do I Select a Sealant?

Sealants must withstand various stresses to perform correctly.

9 desired properties exist – 5 of which are commonly included in crack sealant job specifications (specs).

Importance of the tests and resulting failures if sealant does not maintain said property.

Understanding desired properties to select the appropriate sealant for the job.
Asphalt Rubber Sealants
(+/- 150°F)

- Good basic sealant, not as high performing as other sealants
- The Composition of this product is AC + Tire Rubber
- Softening Point (Liquid)
  - Tracking & Bleeding will happen at pavement temps 20° to 30 ° lower
- Great aging properties

- When do you choose AR Sealants?
  - Maintenance (something to do now until future repairs available)
  - Good in weak pavements, will not tear older pavements apart (break cohesively before adhesively)
AR & Polymer Modified Sealants
(+/- 180°F)

Better performing sealant.
The Composition of this product is AC + Tire Rubber + Polymer (Virgin Rubber)
  • What are Polymers?
  • Higher Softening Point than AR
  • Lower Flex Temp. than AR
  • Medium Viscosity (wear better than ARs)
  • Highly Adhesive
  • Good aging properties

• When do you choose AR & Polymer modified sealants?
  • Maintenance
  • Good in weak pavements
  • Need better high & low temp properties than AR
Polymer Modified Sealants
(+/- 230°F)

Best/Higher performing sealants than ARs or AR/Polymer modified sealants.
Provides performance across wider range of temperatures

- The Composition of this product is:
  - AC, Less or No Tire Rubber, More Polymer (Virgin Rubber)
  - Lower temperature flexibility works better in areas with lots of thermal movement
  - Medium or Low Viscosity (ease of installation)

- When do you use Polymer Modified Sealants?
  - Wide temperature range of performance
  - Greater thermal movements
  - Lower viscosity to flow into smaller joints and cracks
HIGH RUBBER Sealants
(+/- 230°F)

- The Composition of this product is:
  - AC
  - Tire Rubber
  - More Polymer (Virgin Rubber)

- High Viscosity
- Better Adhesive Properties
- Low internal strength / breaks before it ropes out
- Best overall performance in the pavement
Low Resilience Sealants
(+/- 230°F)

The Composition of this product is:
• AC, Some Tire Rubber, Different Polymer (Virgin Rubber)
• High Softening Point
• Lower Flex Temp.
• Medium or Low Viscosity
• Adhesive
• Stress Relaxes under extension

• When do you choose LR sealants?
  • Excellent for AC crack sealing.
  • Low force on the bond surface (low elasticity)
  • Extreme cold climates
Parking Lot Sealant
(+/- 210°F)

The Composition of this product is:
- AC, No Tire Rubber, Polymer (Virgin Rubber)
- Very High Softening Point
- Good Lower Flex Temp.
- Low Viscosity
- Adhesive
- **When do you choose Parking Lot Sealants?**
  - Parking Lots
  - Residential areas
  - Areas with slow moving, parked traffic, foot traffic
  - Resistant to tire scuffing, foot traffic, high heels, parked cars etc.
Direct Fire Sealant
(+/- 210°F)

The Composition of this product is:
• AC, No Tire Rubber, Special Polymer (Virgin Rubber)
• Very High Softening Point
• Good Lower Flex Temp.
• Low Viscosity
• Adhesive
• Resistant to tire Scuffing & Foot Traffic.
• Designed to handle direct heating
• Still needs agitation

• When do you choose DF sealant?
  • Non-oil jacketed melters
Fiber Sealant
(+/- 210°F)

The Composition of this product is:
- AC, No Tire Rubber, Polymer, Fibers
- Very High Softening Point
- Good Lower Flex Temp.
- **HIGH Viscosity**
- Adhesive

- **When do you choose Fiber Sealants?**
  - Durable OVERBAND
  - Low moving cracks
  - Canals, high slope areas
Questions?
Materials Knowledge Check

Knowledge Check
QUESTIONS
What type of failure occurs when the sealant remains adhered to the walls of the crack but the sealant in the void of the crack splits?

A. Adhesive failure  
B. Cohesive failure  
C. Substrate failure  
D. None of the above
The tracking of cured crack sealant by vehicles is most likely due to:

A. Lack of compatibility between crack sealant and asphalt

B. A pavement temperature higher than the sealant is designed to withstand

C. Very cold pavement temperature

D. Incompressible materials entering the crack
Which of the following best describes the stresses to which crack sealant must withstand?

A. Horizontal expansion and contraction from seasonal temperature changes

B. Environmental aging effects

C. Abrasion (traffic, street sweeping, snowplows)

D. All of the above
Module 4
Installation
Best Practices

Construction Best Practices

- Preparation
- Reservoir Cutting
- Proper Sealant Heating
- Maintaining Melter Temperatures
- Equipment
- Application Configurations
- Finishing
- Personnel, Traffic Control, Safety, Opening to Traffic, and Re-sealing
Preparation Best Practices

- Structurally sound pavement
- Dry Crack
- Clean Crack
Structurally Sound Pavement

- Intact Bonding Surface
- Tight, strong surface
- No surface raveling
- No Loose aggregate
Dry Crack

SURFACES NEED TO BE DRY

DRY PAVEMENT SURFACE AND CRACK INTERIOR

NO DAMPNESS

NO DARKENING OR DISCOLORATION DUE TO MOISTURE

NO FROST OR DEW

MOISTURE WILL PREVENT PROPER ADHESION AND GUARANTEE SEALANT FAILURE
Weather Considerations

Ideal Conditions:
• Moderate to warm temperatures
• Little to no wind
• Spring and Fall
Weather Considerations:

- Wind
- Temperature
  - 40° F (4° C) and rising
  - Hot air lance in cooler conditions
  - Cloud coverage and shade
  - Rain
Clean Crack

- Surfaces Need To Be Clean
- Pavement surface and crack walls free from dirt and debris
- Dirt will prevent proper adhesion
Crack Cleaning

- Compressed Air
- Vacuum in combination with compressed air
- Hot Air Lance
- Wire Brushing

*Cleaning operations should take place immediately before crack sealing*
Compressed Air

Crack cleaning via Compressed Air:

• Blow out debris, dirt, weeds etc.
• Blow debris away from traffic and co-workers
• Ensure that operator is staying within the traffic control lane during cleaning
• Ensure sufficient pressure and velocity
  • Recommended air pressure minimum 90 PSI
• “Finger Test” inspection to determine if cleaning is sufficient
• Compressed air is the most common method to clean and prepare cracks
Compressors

- High pressure air compressors are effective at cleaning out cracks prior to sealing; an important step in the application process
- Ensure compressor capacity to maintain effective high pressure
Crack Cleaning w/ an Air Compressor
Vacuum Systems

- Vacuum systems
- Environmentally Friendly
- Required in certain areas that have PM10 regulations
- Injects compressed air into crack removing debris and then vacuums debris into vacuum. Fines are filtered and cleaner air is released into atmosphere
Vacuum Systems

Truck mount Vacuum

• Vacuums debris out of crack; useful in areas that are sensitive to air quality
• Less dust than blowing out a crack with compressed air
• Cleaner work environment

Trailer mount Vacuum
Vacuum Systems
Hot Air Lancing

- Hot Air Lancing
  - Removes debris, burns weeds, removes moisture, and warms pavement
- NEVER to be used to continue work during rain or when pavement surface is saturated
- Conditions where hot air lancing is frequently recommended:
  - Moist climates
  - Nighttime crack treatment projects
  - Temperatures below the dew point
Hot Air Lances

- Dry crack
- Soften, warm pavement for increased adhesion
- One pass is usually sufficient
- Careful not to excessively heat pavement
  - Extreme darkening of pavement
  - Smoking
  - Dislodgement of aggregate
**Hot Air Lancing**

**Proper Use**
- Slight darkening of pavement
- Do not apply direct flame to pavement
- Smoke is an indication of scorching – operator may be moving too slowly
- Crack seal immediately following heat lancing
- Excessive bubbling of sealant is indicator that pavement needs to be dried to a greater degree
Wire Brushing

- Wire Brushing
- Wheel mounted units: rotating, narrow, round wire brush that runs through crack to remove debris
- May be used along with compressed air
- Brushes wear quickly, requiring frequent change
Improper Cleaning
Crack Cleaning Questions?
Reservoir Cutting

- Routing is an effective method to cut a designed reservoir and is also an effective method to clean crack face, provides ability for sealant to accommodate crack movement
- Straight, uniform reservoir is best
- Production depends on pavement conditions but in studies has ranged from: 220 meters (~720 linear feet/hr) up to 300-600 meters (1,000-2,000 linear feet/hr)
Rotary Impact Router

- Most widely used reservoir cutting equipment
- High productivity of 600-800 linear feet per hour
- Follows meandering cracks well
- Depth control
- Variety of models and options available
Reservoir Cutting

Reservoir dimensions should follow the project design. Here are some general best practices for routing reservoirs:

• Produce an equal cut centered over the crack for uniform bond on both sides of the crack
  • Rout at least 3mm (1/8”) from each side of the crack

• Cold weather climates may require wider reservoirs.
  • Reservoir should never be greater than 38mm (~1.5 in) wide and never less than 10 mm (~3/8 in) deep

• Stop if excessive spalling occurs
  • Router should follow crack without difficulty
  • Minimize spalling and cracking
Reservoir Cutting
Blade condition is key to production of a properly shaped reservoir!

Best Practices:

- Read operation instructions
- Wear PPE (personal protective equipment)
- Pre-check router to ensure good working condition
- Get router head up to speed and then lower into the crack
- Rout over the center of the crack
- Rout from centerline to shoulder to remain in traffic control lane/avoid traffic

Cutters

Rout from center lane to shoulder
Reservoir Cutting

• Check cutters frequently during use (rotate when appropriate)
• Pay attention during operation for any noise that indicates an issue or excessive vibration
• Have correct amount of washers/spacers to reduce ‘wobble’ – which reduces physical effort of operation and provides a cleaner cut
• Avoid routing alligatored areas or poor pavement conditions

This cutter is rounded and needs to be replaced

This cutter has rounded edges on the inside and shows how it was rotated to provide a square outside cutting edge
Router Maintenance

- Always refer to the Manufacturer’s recommendations
- Change fuel filter
- Change engine oil
- Check lubrication
- Check belt tension
- Overall visual inspection of components
Routing Questions?
Proper Sealant Temperature

• Follow the Manufacturer’s recommended application temperature range!!
  – Common Minimum-Maximum application temperature range is 380°F - 400°F
• Over-heating or under-heating the sealant will result in limited performance and/or failure
Proper Sealant Heating

- Load and heat sealant prior to planned start of installation
- Always apply product within manufacturer’s minimum and maximum temperature range
- Inspect your temperature regularly
- Overheating may damage product properties
- Under-heating may cause adhesion issues
Maintaining Temperature

- Agitation should be continuous; except when melter lid is opened to add sealant
- Agitation increases heating and maintains sealant temperature uniformity
- Add sealant blocks equal to installation rate to best maintain sealant temperature – avoid adding many blocks all at one time
Maintaining Temperature

- Heating for too long at high temperatures can damage sealant
- Thickening or gelling (getting “stringy”) are signs of overheating
- In this case; sealant must immediately be drained from melter and disposed
- Using damaged sealant may result in: adhesion, tracking/bleeding issues
- Always follow manufacturer’s instructions for heating temperatures
Proper Pavement Temperature

- Pavement Temperature 40°F minimum
- CAUTION should be observed when applying products below the dew point
- Hot Air Lance can be used to warm the pavement
Re-Heating

- Some manufacturers recommend to attempt to use all sealant on the day of installation. Check manufacture recommendations to ensure you are following their instructions for re-heating.
- Some sealants can be reheated; check manufacturer’s instructions
Heating & Maintaining Questions?
Sealant Melters

- For application of hot applied sealants
- Variety of manufacturers, capacities, fuel sources, melt rates and features
- Units range from small direct fire equipment to large dual pump and wand applicators with onboard air compressors
Small Direct Fired Melter

- For small project usage ONLY
  - Parking lots, residential driveways
  - Manual propane burner and agitation
- Ensure sealant is appropriate for direct fire unit as not all sealants are compatible with this unit
- Maintain appropriate temperature and constant agitation to guard against overheating of sealant
Small Direct Fired Melter

- Operation:
  - Light torch and insert into heating compartment
  - Bring material to appropriate temperature (ensuring material is appropriate for a direct fire unit)
  - Add additional block of material once unit reaches half capacity
Most hot applied sealants are heated and installed using oil jacketed double boiler melters:

- Heats and melts sealant to application temperature
- Agitates sealant inside tank
- Pumping system to feed material through hose, wand and into crack.
- Temperature control system provides safer and more controlled method of heating sealant
Oil Jacketed Double Boiler Melters

- Variety of sizes and features
  - 50 - 400+ gallons
  - Towable trailer units
  - Skid mounts
  - Gravity
- Diesel or propane fired burners
Gravity Feed Melters

50 gallon capacity

400 lb per hour melt rate
Application Tools

- Hoses & Wands
- Wand tips
- Squeegees
Hoses

- Hoses are available in heated and unheated versions
- Variety of manufacturers and lengths

Some larger melters are equipped to handle two hoses per unit for higher production.
Wands

• Wands attach to the hose in order to apply sealant to the ground

• Trigger and valve controlled wands are most common
Wand Tips

- Straight Tip
- Elongated Sealing Tip
- Flush Sealing Tip
- Metal Squeegee Tip
- Anti-Drip Tip
- Sealing Shoe
- Swivel Disc
Squeegees

- Squeegees are commonly used for crack sealing
- Smooth and level sealant
- Form overbands
- Force sealant down into crack for greater contact/adherence to crack walls
- Typical overbands should extend 1” beyond the crack on each side
Equipment Questions?
Proper installation is a must!

Proper Application
PROPER OVERBAND

• Narrow
• Tight to the pavement
• Pavement texture visible through sealant
Improper Application
Finishing

Good applications are achieved by:

1. Meeting the project design configuration: (Flush, Overbands, Reservoirs, Combination)

2. Performing good, clean applications free from drips, puddles, and excess sealant
Common Finishing Issues

1. Sagging
   • Apply a second coat to achieve desired level

2. Puddling
   • Turn and go back over crack to make a smooth, even application

3. Drips and excessive application
   • Use a drip stopper
   • Avoid poor workmanship
Application Configuration Questions?
Traffic Control

Traffic control should be designed in accordance with part 6, Temporary Controls, of the FHWA Manual on Uniform Traffic Control Devices or as per the project specifications:

- Treatments typically performed one lane at a time
- Traffic controls move as the work zone proceeds
- Lane closure time should be appropriate for product to cooled/cured to bear traffic
Personnel Requirements

Typical Crack Treatment Crews have 4-5 workers. Additional personnel will be needed depending upon the requirements of the project. Here are some of the most common functions in a crack sealing operation:

- Traffic Control
- Router Operator
- Air Compressor Operator
- Driver
- Sealant Loader
- Sealant Operator
- Squeegee Operator
- Detack/Finishing
- Clean-up
- Maintenance
Inspections

Crack treatments need monitoring and inspection throughout the process to ensure installation proceeds as planned including:

- Equipment
- Sealant used
- Reservoir dimensions
- Crack cleanliness and dryness
- Application temperatures
- Weather conditions
Clean Up

- Care should be taken to clean up all garbage, materials, traffic control items, and debris after any crack treatment
- Excessive sealant/spills should be removed
- Sealant boxes and packaging materials need to be disposed
- All debris must be removed: blowers, backpacks, street sweepers and/or vacuums may be used
  - blow away from traffic and people
- Traffic control items including cones and signs should be removed
Opening to Traffic

• Crack treatment areas should not be opened to traffic or pedestrians until:
  – the sealant has cooled to the pavement surface temperature
  – Cured sufficiently to not be affected by traffic
• Application configurations should be taken into consideration
• De-tacking products may be used to open treatments to traffic more quickly

Keep traffic off treatment until sufficiently cooled or cured
Blotting materials such as sand, portland cement, lime, slag, etc. are not recommended. These blotters can be abrasive and alter the properties of the sealant affecting flexibility and extension. Toilet paper is not recommended.
Re-Sealing Procedures

1. Remove old sealant
   - If old sealant is not removed; use a hot air lance on old sealant to help new sealant adhere

2. Remove debris and moisture; air compressor.

3. Hot air lance to remove moisture and heat old sealant to create a better bond between old and new sealant.

4. Fill the crack with sealant from bottom to top to ensure a complete seal.

5. Overband using a sealing disc or squeegee. Overbands should extend approximately 1” beyond each side of the crack.
Safety Hazards

Hazards:

- Exposure to traffic
- Elevated temperature materials
- Proximity to powered equipment

Always read the manufacturer’s operation and safety manuals prior to working with equipment and sealant materials.
PPE of the Past
Dress for Safety! PPE!

When operating equipment and/or working with hot materials always wear the following or as required by your employer:

– Long pants
– Long sleeved shirt buttoned at wrist
– Heat resistant gloves
– EYE PROTECTION (safety glasses or face shield)
– HARD SOLED SHOES or BOOTS
– Traffic safety vest and hard hats
Deep fryers and turkey fryers cook between 330-350 degrees. Most sealant is applied at 380-400 degrees.
First Aid for Asphalt Cement Burns

1. Cool the asphalt cement and affected body part.
2. Do NOT apply ice directly on affected area.
3. Leave cooled asphalt cement on area. **DO NOT ATTEMPT TO PEEL OFF MATERIAL!**
4. **Mineral Spirits will dissolve crack sealant from skin**
5. Get to a doctor’s office or hospital as soon as possible
Safety Recommendations
Questions?
Proper Installation
Knowledge Check

Knowledge Check
QUESTIONS
What should the router operator do if spalling occurs?

A. Reduce the throttle speed of the engine
B. Raise the throttle speed of the engine
C. Raise the cutter mechanism on the router
D. Inspect for worn cutters, verify that the appropriate cutter is being used for the designed reservoir, verify pavement condition is appropriate for routing, and walk at a slower pace while routing
At a minimum, how frequently should an operator check the cutters on a router for wear?

A. During each break or when excessive spalling occurs
B. At the beginning of each day
C. Every other day
D. Once per week
Which of the following steps should be part of a procedure for cleaning cracks with an air compressor?

A. Verify that the compressed air is between 50 and 60 psi

B. Check for the presence of moisture or oil in the compressed air by blowing the airstream onto a piece of cardboard

C. Wait at least 24 hours after cleaning cracks before sealing them

D. All of the above
What is the purpose of blotting material?

A. Prevents sealant pick-up on tires
B. Accelerates curing time
C. Absorbs any sealant puddles
D. All of the above
What is the minimum recommended pressure range for an air compressor performing crack cleaning?

A. 40-50 psi  
B. 50-75 psi  
C. 90-100 psi  
D. 125-150 psi
When should sealant blocks be added to the melter?

A. Every 15 minutes of sealing
B. For each block of material placed, a block should be added
C. When the melter reaches half empty
D. Sealant can be added at any time as long as the melter maintains a steady flow of sealant
Thickened, gelled, or stringy sealant coming out of the wand is a sign of what?

A. The sealant has not been properly heated in the melter
B. The sealant has cooled in the hose
C. The sealant has been heated to elevated temperatures beyond its pot life
D. The wand type needs to be changed
Which of the following is a step that should be taken when resealing an existing crack?

A. Remove all existing sealant that is brittle

B. A hot air lance should be used to heat old crack sealant to bond with new crack sealant

C. Sealed or filled cracks that have deteriorated should be cleaned with an air compressor

D. All of the above
When loading sealant to the melter during crack treatment operations, it is recommended to let the melter empty completely, and then add many blocks all at once to refill and continue operation.

A. True
B. False
During crack treatment operation AGITATION of material in the melter should be:

A. Continuous at all times
B. Continuous except when sealant is being added and lid is open
C. Performed only when necessary to mix material
D. Performed as infrequently as possible
Which of the following are common finishing issues to be avoided when installing sealant in crack treatments? Select all that apply:

A. Sagging
B. Puddling
C. Drips and excessive application
D. Reservoir
The purpose of the oil jacketing system on a double boiler melter is to:

A. Provide an even distribution of heat around the walls of the tank
B. Prevent “hot spots” often associated with direct fire units
C. Prevent the sealant from losing its desired properties in the melter
D. All of the above
A vacuum system should be used in a crack cleaning operation when:

A. Working in an area that is sensitive to air quality
B. Moisture is present in the crack
C. A sweeper is unavailable
D. All of the above
Which of the following statements about crack routing are true?

A. Rotary impact routers should be used on high moving cracks

B. Routing can inflict additional damage to old, oxidized pavements

C. Can double the sealant service life

D. All of the above
Which of the following wand tips are used to apply an overband?

A. Straight
B. Sealing disc
C. Elongated
D. Flush
Which of the following is NOT a function of a squeegee?

A. Forces sealant down into the crack for greater adherence to crack walls
B. Smooth out and level the sealant
C. Used for flush fill applications
D. Forms sealant to the appropriate width
Which of the following circumstances warrant the use of a hot air lance?

A. To dry out a saturated pavement

B. To heat pavement that is less than 40 °F (4 °C)

C. To dislodge aggregate from the edge of the crack

D. None of the above
Cracks that are routed and sealed achieve over 100% (2x) the service life vs. non-routed and sealed cracks:

A. True
B. False
Select all that apply: which of the following are used in crack cleaning operations:

A. Compressed Air
B. Vacuum Systems
C. Hot Air Lance
D. Wire Brushing
Questions??  Thank You!