AHD25 Recorded Webinar Series
Part-2: Asphalt Crack Sealing Basics

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University of New Hampshire
About the AHD 25 webinar series…

• The webinar series is designed to serve as a best practices and technology transfer tool

• This is second of two recorded webinars for 2015

• Previous webinar: Concrete Joint and Crack Sealing Basics (Scott Eilken and Dan Zollinger)

• We are always looking for other webinar ideas and speakers
  • Committee Chair: Jim McGraw (jim.mcgraw@state.mn.us)
  • CCC: eshan.dave@unh.edu
Webinar Objectives

The focus of this webinar is to present the proper techniques for preparation of cracks and joints in concrete pavements and installation of sealants.

- Summarize why cracks should be sealed
- List the types of equipment used for sealing in asphalt pavement
- Understand how to choose the appropriate sealant configuration
- Recognize how to select the proper sealant material
- Understand how to properly clean and prepare cracks
- Gain knowledge on how to properly install sealants
- List typical failure types and their causes
Presenters

Larry Galehouse  
NCPP, MSU

Jim Chehovits  
Crafco Inc.

Kevin Kruckow  
Fahrner Asphalt
Crack Treatments

Larry Galehouse, P.E., P.S.
Director, National Center for Pavement Preservation
Crack Treatments are 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 an agency’s investments
- Maintains pavement structure
- Limits future deterioration, prevents potholes
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>Crack Sealing</td>
<td>Crack Filling</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</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>
What is Crack Sealing and Crack Filling?

Crack Sealing

Crack Filling
Why Use Crack Treatments?

- Reduces water penetration into underlying pavement layers, thus maintaining base strength near the crack.
- Reduces incompressibles, thus reducing crack growth and raveling.
Benefits of Crack Treatment

- Slows pavement deterioration
- Prevents future roughness increase
- Reduces potholes
- Slows crack spalling
- Extends pavement life from 1 to 4 years
Benefits of Crack Treatment

Performance Curves: control vs Treated -- Highway 11 (Ontario)

- Control
- Treated

Years of Service: 1985 to 1998

Pavement Condition Index

Minimal acceptable level

Predicted
Project Selection

Cracks = Distresses

- Type of Crack(s)
- Severity of Crack(s)
- Amount of Cracks
<table>
<thead>
<tr>
<th>Flexible Pavements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Alligator (fatigue) Cracking</td>
</tr>
<tr>
<td>2. Bleeding</td>
</tr>
<tr>
<td>3. Block Cracking</td>
</tr>
<tr>
<td>4. Corrugation</td>
</tr>
<tr>
<td>5. Depression</td>
</tr>
<tr>
<td>6. Joint Reflective Cracking</td>
</tr>
<tr>
<td>7. Lane/Shoulder Drop Off or Heave</td>
</tr>
<tr>
<td>8. Lane/Shoulder Separation</td>
</tr>
<tr>
<td>9. Longitudinal &amp; Transverse Cracking</td>
</tr>
<tr>
<td>10. Patch Deterioration</td>
</tr>
<tr>
<td>11. Polished Aggregate</td>
</tr>
<tr>
<td>12. Potholes</td>
</tr>
<tr>
<td>13. Pumping &amp; Water Bleeding</td>
</tr>
<tr>
<td>14. Raveling, Weathering, Stripping</td>
</tr>
<tr>
<td>15. Rutting</td>
</tr>
<tr>
<td>16. Slippage Cracking</td>
</tr>
<tr>
<td>17. Swelling</td>
</tr>
</tbody>
</table>
Type of Distresses (includes Cracks)

Rigid Pavements

1. Blowup
2. Corner Break
3. Depression
4. Durability (“D”) Cracking
5. Faulting of Transverse Joints & Cracks
6. Load Transfer Associated Deterioration
7. Joint Seal Damage
8. Lane/Shoulder Drop Off or Heave
9. Lane/Shoulder Joint Separation
10. Longitudinal Cracks
11. Longitudinal Joint Faulting
12. Patch Deterioration
13. Popout
14. Pumping & Water Bleeding
15. Reactive Aggregate
16. Scaling, Map Cracking
17. Spalling
18. Swell
19. Transverse and Diagonal Cracks
Severity of Crack

Crack Width

Crack Width

Edge Stripe

SHOULDER

Traffic
Severity of Crack

Note: Rate entire crack at highest level present for 10% or more of total crack length
Severity of Crack

Moderate - Adjacent Low Severity Cracking
High - Adjacent Moderate Severity Cracking
Amount of Cracks

Acceptable

Too Much
Flexible Pavement Cracks
Cracks occur when the asphalt is no longer flexible enough to resist movement due to:
- Traffic loadings
- Seasonal temperature changes

Asphalt is most flexible and resistant to cracking at construction.
Transverse Cracks

- Transverse cracks form perpendicular to the pavement lane
  - Thermal
  - Reflective
- Typically caused by environmental factors and by reflection of underlying joints
- Often experience concentrated and extreme movement
- Crack Sealing (and routing when appropriate) is recommended to accommodate the expected crack movement.
Longitudinal Cracks

- 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 Cracks

• 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.
Edge Cracks

- 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 Cracks
Also known as Alligator Cracks

- 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” as a pre-treatment to other surface treatments.
Reflective Cracks

- Unique to asphalt surfaced PCC pavements
- Includes all longitudinal and transverse cracks that appear on top of the PCC joints
- Caused by movements in the PCC slab beneath the asphalt because of thermal and/or moisture changes
- Reflective cracks start at the bottom of the AC surface and eventually propagate toward the pavement surface
• Longitudinal cracks occur generally parallel to the centerline of the pavement.
• Often caused by improper construction practices.
• Consider crack sealing at low severity levels.
Commonly Missed Opportunities for Crack Treatments

Water Entry
Commonly Missed Opportunities for Crack Treatments

Water Entries
Crack Treatment Best Practice
Commonly Missed Opportunities for Crack Treatments

Water Entries
Commonly Missed Opportunities for Crack Treatments

Water Entries
Commonly Missed Opportunities for Crack Treatments
Crack Treatment Best Practice
Crack Treatment Best Practice

Seal Joints at Patches
Questions
Sealant Selection for Crack Treatments in Asphalt Concrete Pavements

Jim Chehovits
Vice President Operations
Crafco, Inc
Presentation Topics

• Factors Influencing Sealant Selection
• Needed properties of sealing materials
• Determining temperature exposures
• Pavement condition / crack movements
• Properties/specifications of material types
• Sealant Selection
Project Specifications

• The Sealant material specification is the major factor influencing material selection

• Current Specifications are provided by
  – ASTM
  – AASHTO
  – Federal Government
  – European Union
  – State/Government Agencies
  – Local Requirements
Project Factors

- Climate at the Location
- Crack Types, Spacing, Condition
- Traffic Conditions
  - Volume, Speed,
  - Parking Lot
- Slopes/ super elevation
ASTM D6690 General Requirements

- Resilient and adhesive compound
- Effectively seals joints and cracks from moisture and foreign material throughout repeated cycles of expansion and contraction with temperature changes
- Will not flow or be picked up by tires
- Completely fill joints
- Relatively unchanged for 6 hour heating
Desired Performance

Crack sealing materials need to remain functional without tracking, losing adhesion or cracking throughout:

The entire temperature range experienced and

The range of movements experienced
Temperature Range

• How Hot???
• How Cold???
• FHWA LTPPBind, at surface level
LTPPBind V 3.1 98% High
LTPPBind V 3.1 98% Low
Using LTPPBind to Improve Crack Sealing in Asphalt Concrete Pavements

FHWA Contact: Antonio Nieves, 202-493-3074, antonio.nieves@fhwa.dot.gov

The Challenge
Repairing cracks in asphalt concrete pavements is essential to ensuring pavement performance and reducing life-cycle maintenance and replacement costs. One of the ways to extend pavement life is to include crack-sealing treatments as part of pavement preventive maintenance practice. The effectiveness of these treatments depends on many factors, including the properties of sealant materials, installation methods, temperature extremes, pavement conditions, traffic levels, and crack movements.

Sealants with different properties are needed in different climates. Warm climates require stiff sealants to resist hot summer temperatures. If the sealant is too soft, it may flow or be pulled from the crack by vehicle tires. Softer, more flexible sealants are more appropriate for cold climates in which pavements are prone to large crack movements, especially during the winter. In any given climate, sealant materials must function over the range of temperature from summer to winter.

Installation methods also vary by climate. Correct installation ensures that the sealant can conform to crack movements in the pavement. The tendency of pavement cracks to widen or move in the winter increases as the distance between existing cracks and variations in winter and summer temperatures increase. If the installation is not correct, cracking or debonding may develop as cracks widen in the winter.

Pavements in good condition that demonstrate transverse thermal cracking, but otherwise have minimal cracking, are best treated with most and seal procedures. These procedures use very flexible and extensible sealants in widened reservoirs with working cracks that move more than 3 millimeters (mm) throughout the year. For pavements with more extensive cracking, such as longitudinal, block, fatigue, and closely spaced transverse cracks in which crack movement is minimal (less than 2 mm a year), techniques such as crack filling, close and seal, and overband are appropriate. These techniques use stiffer, more traffic-resistant sealant materials in cracks that generally are not widened.

In the past, highway agencies from across the United States have developed area-specific crack-sealing treatment procedures through a series of test sections, evaluating and investigating sealant types and installation methods by trial and error. Selecting sealant materials for specific climates has been based on approximate descriptions of temperature ranges in hot, moderate, or cold climates, and with some general air temperature highs and lows.
Crack Movements

- Horizontal – slow, yearly, daily
  - Thermal expansion and contraction as temperature changes from hot to cold
  - Measured from the highest and lowest temperatures experienced during the year
  - Movements proportional to crack spacing
  - Movements up to 1 inch can occur in severe climates with 100 ft crack spacings
  - Typical maximum movement of 0.1” per 10 ft crack spacing in severe climates
Crack Movements

Figure 12c  Crack movement, crack No. 1, pos. 1 B
Movement Percentage

- Movement % 0 to > 100%
- Example - ½ inch wide in summer when sealant installed, opens to 1 inch in winter equals 100% crack movement
- Sealant would be subjected to 100% elongation from summer to winter
- If crack widened to 1 inch reservoir when installed, elongation reduces to 50%
Pavement Condition

• Type of Cracks
• Extent of cracking
• Crack Spacing
• All Influence Crack Movements
• **Working** - >1/8 inch movement,
  – Typically transverse at over 15-20 ft.
  – **Use Crack Seal Process**

• **Non-Working** - < 1/8 inch movement,
  – Typically longitudinal, transverse or other at less than 15-20 ft.
  – **Use Crack Fill Process**
Milwaukee, Wisconsin

Transverse Thermal Working Cracks

Spacing  50 to 75 ft

High Movement  est ½ inch +

58-28  98%
LTPPBind Area
Silverton Colorado

Transverse Thermal Working Cracks

Spacing 15 to 30 ft

High Movement est ¼ inch

46-34C 98% LTPPBind Area
Prescott Arizona
Random, Aging, Thermal Non-Working Cracks
Spacing 1 to 10 Ft
Low Movement est <1/8 inch
64-16C 98% LTPPBind Area
Sealant Properties Influencing Selection

• Application Temp - Viscosity
• High Temperature- Softening point, flow, 122 or 140F penetration
• Low Temperature-Bond, flexibility, 0F penetration
• Adhesion- Bond, tensile adhesion
• Elasticity - resilience
# Proposed SG Specification

<table>
<thead>
<tr>
<th>Crack Sealant Performance Grade</th>
<th>SG 46</th>
<th>SG 52</th>
<th>SG 58</th>
<th>SG 64</th>
<th>SG 70</th>
<th>SG 78</th>
<th>SG 82</th>
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</thead>
<tbody>
<tr>
<td>Installation Temperature</td>
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<td></td>
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<tr>
<td>Apparent Viscosity, SC-2</td>
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<td>Maximum Viscosity (Pa.s)</td>
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<td>3.5</td>
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<tr>
<td>Minimum Viscosity (Pa.s)</td>
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<td>1</td>
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<tr>
<td>Vacuum Oven Residue (SC-3)</td>
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<tr>
<td>Dynamic Shear, SC-4</td>
<td>46</td>
<td>52</td>
<td>58</td>
<td>64</td>
<td>70</td>
<td>76</td>
<td>82</td>
</tr>
<tr>
<td>Minimum Flow Coeff. (kPa.s)</td>
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<tr>
<td>Minimum Shear Thinning</td>
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<td></td>
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<td>0.7</td>
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<tr>
<td>Crack Sealant BBR, SC-3</td>
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<td></td>
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<tr>
<td>Maximum Stiffness (MPa)</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Avg. Creep Rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Crack Sealant DTT, SC-6</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Minimum Extendibility (%)</td>
<td></td>
<td></td>
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<tr>
<td>Crack Sealant AT, SC-7</td>
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<tr>
<td>Minimum Load (N)</td>
<td>50</td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

*Note: Crack sealant surface energy is provided by manufacturer.*
Material Types

• Unmodified asphalt cements, emulsions, cutbacks  ASTM D6373, D977
• Fiber Modified
• Ground Tire Modified  ASTM D5078
• Polymer Modified /Rubberized  
  ASTM D6690  Type I-IV, Agency specs
• Combinations
Unmodified Asphalts

- Crack at approx 0 to -5 C (20-30F)
- Excessive softening above 40- 50 C (104 - 120F)
- Fill Use
- Typical effective range of 0 C to 50C (30-120F)
- Typically < 1 year life
Fiber Modified

- Provides Tensile Reinforcement
- Improves High temperature stiffness
- Improves low temperature cracking resistance
- Overband Fill applications
Ground Tire Rubber Modified

• Swells in the asphalt
• Increases high temperature stiffness
• Improved low temperature flexibility and fracture resistance
• Increases elasticity
• Generally Fill use
Polymer Modified / Rubberized

- Can provide high levels of modification
- Improves low and high temperature properties
- Can provide high levels of low temperature extensibility
- Can be Fill or Seal Use
- Effective ranges from -46 C to 82 C (-50 to 180F)
Sealant Selection

• Low Temperature
  – **Crack Seal** - Pass bond test at the determined low temperature 50-200%
  – **Crack Fill** - Pass a mandrel bend test at the determined low temperature - 10% elongation
Sealant Selection

• High Temperature
  – Crack Seal - Meet D6690 Softening Point requirements of 80 °C (176 °F) minimum and be at least 16 °C (29 °F) above the high pavement temperature

  – Crack Fill - Minimum D36 Softening Point of 22 °C (40 °F) above high pavement temperature, and lower penetration results for higher pavement temperature areas
### General Specification Applicability

Seal and Fill Use

<table>
<thead>
<tr>
<th>Type</th>
<th>High Temp (°C)</th>
<th>Low Temp (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type IV</td>
<td>52, 58</td>
<td>-28, -34, -40, -46</td>
</tr>
<tr>
<td>Type II, III</td>
<td>52, 58, 64</td>
<td>-10, -16, -22, -28</td>
</tr>
<tr>
<td>Type I</td>
<td>52, 58, 64</td>
<td>-10, -16, -22</td>
</tr>
<tr>
<td>State/Local</td>
<td>70, 76</td>
<td>-10, -16</td>
</tr>
</tbody>
</table>

Usage may vary depending on specific product characteristics that exceed specifications.
## General Fill Use Applicability

<table>
<thead>
<tr>
<th>Type</th>
<th>High Temp (C)</th>
<th>Low Temp (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D5078</td>
<td>52,58,64</td>
<td>-22,-16,-10</td>
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<tr>
<td>Fiber Mod</td>
<td>52,58,64</td>
<td>-22,-16,-10</td>
</tr>
<tr>
<td>Polymer/GTR</td>
<td>52,58,</td>
<td>-28,-22,-16,-10</td>
</tr>
<tr>
<td></td>
<td>64,70,76</td>
<td></td>
</tr>
</tbody>
</table>

Usage may vary depending on specific product characteristics that exceed specifications.
Additional Considerations

- Sloped Areas: higher viscosity to resist flow
- Winter Installation: may use softer material due to lesser concern on pick up
- Hot Summer: Greater high temp stiffness
- Parking lots: Greater high temp stiffness
- Wide Cracks: Higher viscosity to resist sag
Summary

• Sealant needs to withstand temperature extremes and crack movements

• Temperature extremes can be determined using LTPPBind

• Movements can be estimated from crack types and spacing

• Sealant properties can be matched to temperature extremes and expected movements
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Chandler, AZ 85226
ph: 602-276-0406
FAX: 480-940-0313
jim.chehovits@crafco.com
www.crafco.com
Installation Procedures & Techniques of Crack Treatments in Asphalt Concrete Pavements

Kevin Kruckow, Regional Vice President
Fahrner Asphalt Sealers, LLC
* ALWAYS FOLLOW THE EQUIPMENT & PRODUCT MANUFACTURERS RECOMMENDATIONS
SAFETY FIRST

- PROPER TRAFFIC CONTROL HELPS PROTECT THE WORKERS AND THE TRAVELING PUBLIC
CRACK PREPARATION
Proper Equipment - Routing
PAVEMENT CUTTER
Proper equipment - Routing

Worn Cutters will not provide a good reservoir.

New Cutter

Worn Cutter
FOLLOW THE CRACK AS BEST AS YOU CAN
SOMETIMES PART OF THE CRACKS ARE MISSED
WHILE THE ROUT MIGHT NOT COVER IT, THE OVERBAND FILLER SHOULD
WHAT DO YOU DO WITH WEEDS?
SOME WEEDS CAN BE LEFT BEHIND
THEY SHOULD BE REMOVED BY
THE HIGH PRESSURE AIR
OR THE HEAT LANCE
THE TOP EDGE CAN ALSO BE RAGGED IF YOU ALLOW THE ROUTER TO ADVANCE TOO QUICKLY.
NOTE THAT THE BOTTOM INSIDE EDGE IS STILL QUITE SQUARE.
A closeup shows how a poor rout can be rounded and chewed up. This is not good for long-term adhesion.
FREQUENTLY CHANGE WORN SPACERS AND PINS.
THIS ALSO SAVES ON THE VIBRATION YOU PUT YOUR BODY THROUGH.
Proper equipment - Cleaning
Cleaning Methods

- Compressed air - sufficient pressure and velocity
- Vacuum - in combination with compressed air
- Heat lance - used to warm pavement when needed

Unclean Crack

Clean Crack
- BLOWERS HELP TO REMOVE THE BULK OF THE DEBRIS FROM THE ROADWAY
- TRY TO KEEP IT IN THE PROTECTED WORK ZONE
- The crack needs to be clean and dry.
- Sometimes two passes are needed to clean both sides of the joint.
THE GOAL IS TO KEEP THE DEBRIS FROM THE TRAVELING PUBLIC
Cleaning Methods

HOT-AIR LANCE

Hot Air Lances should be used to dry slightly moist pavement or heat pavement up to 40°F.

THIS PAVEMENT IS TOO WET. HOT-AIR LANCE WILL NOT BE EFFECTIVE. MOISTURE WILL RE-ENTER CRACK BEFORE SEALANT IS APPLIED.
ONE PASS IS USUALLY SUFFICIENT – GO SLOW ENOUGH TO HEAT THE JOINTS – WITHOUT BURNING THE ASPHALT
Proper Equipment - Melters

Melter Applicator

- Oil-jacketed
- Thermostatic heat controls
- Continuous agitation
- Over-heating safety controls
- Right size for operation
- Many commercial versions...

* ALWAYS FOLLOW THE EQUIPMENT MANUFACTURERS RECOMMENDATIONS
Proper Equipment - Melters

- Applicator Tips: Flush Fill
Proper Equipment - Melters

Applicator Tips: Overband
APPLICATION TIPS COME IN ALL SHAPES AND SIZES, DEPENDING ON THE AMOUNT OF FLOW YOU NEED TO CARRY, THE WIDTH OF THE TOP BAND, OR IF IT NEEDS TO BE FLUSH FILLED
ALL FUNCTIONS CAN BE PERFORMED FROM ONE UNIT
TOUCHING UP OLD CRACKS IS COMMON WHILE FILLING NEW CRACKS AS YOU GO
DO NOT OVER FILL THE BOTTOM OF THE RUMBLE
This overband doesn’t appear to be wide enough.
SOMETIMES YOU RUN INTO “SINKERS” THAT MAY NEED MULTIPLE PASSES
OBVIOUSLY, MOST ROADWAYS ARE MAINTAINED ONE LANE AT A TIME
YOU NEED TO CARRY PROPER FLOW TO THE PAVEMENT EDGE TO ELIMINATE OVERFLOW THAT COULD BE CAUGHT BY SNOWPLOWS
THIS LOOKS MUCH BETTER

NOTE THE GREAT ADHESION TO THE ROUGH SURFACE
IN TRAFFIC AREAS AND INTERSECTIONS, USE DE-TACK TO KEEP THE FRESH SEALER FROM ADHERING TO CAR TIRES
PREPERATION IS KEY TO SUCCESS
LEAVING AN EFFECTIVE PAVEMENT REPAIR
Fahrner Asphalt Sealers, LLC
6615 US Hwy 12 W.
Eau Claire WI , 54703
Phone: 715-874-6070
Fax: 715-874-6717
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