Crack Sealing Innovations

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Rocky Mountain West Pavement Preservation Partnership Meeting

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Innovation -- Definitions

- An improvement to something already existing
- A new idea, device, method, or process
- Application of a better solution to meet needs
- Translating an idea into good service that creates value

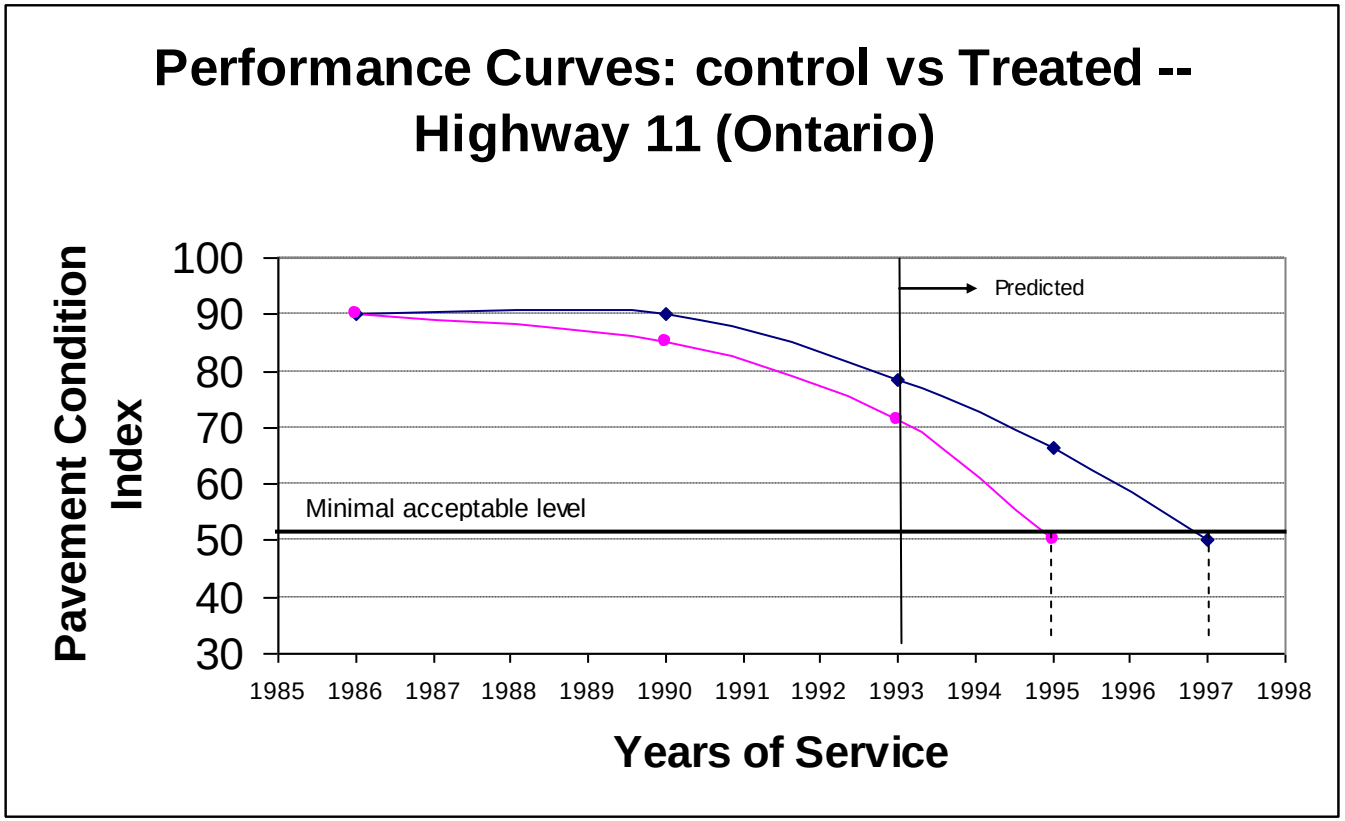
Areas of Innovation in Crack Sealing

- Benefits of Crack Sealing
- Crack Seal and Crack Fill
- Design Process
- Meltable Packaging
- Mastics
- Equipment

Benefits of Crack Sealing

- Slows pavement deterioration rate
- Slows roughness increases
- Reduce pothole and depression formation
- Slows crack spalling
- Extends pavement life
- Cost effective
- Effective pretreatment for other preservation processes

Longer Pavement Life



Crack Seal and Crack Fill

- From FWHA RD-99-147 report, SHRP H-106
- Different techniques should be used for high movement and low movement cracks
- Crack Seal - high movement > 1/8 in/yr
  - Thermal transverse, > 15-20 ft spacing
  - Extensible sealants in designed reservoirs
- Crack Fill - low /non-moving <1/8 in/yr
  - Longitudinal, close transverse < 15-20 ft
  - Installation in cleaned cracks or reservoirs

NCHRP Report 784 Best Practices for Crack Treatments

- 62% of survey respondents made no distinction between crack seal and crack fill
- Generally Crack Sealing used in cold climates and transverse cracks and Crack Filling in warmer climates and longitudinal cracks
- Many agencies do not differentiate between processes which likely precipitates some performance issues
- Some agencies have developed different processes
- Determining Crack Seal or Crack Fill is considered the Best Practice for evaluation of cracking

Crack Treatment Design Process

1. Pavement Evaluation
2. Temperature Ranges
3. Installation Geometry
4. Sealant Selection
5. Installation

Step 1- Pavement Evaluation

- Examine pavement for applicability and determination the of crack treatment process

- Intact defined cracks
- Max width 1.5 in
- Minimal base damage
- PCI Range 40-90
- Condition can be too bad for crack sealing & filling
- Crack spacing & density
- Determine Seal or Fill

Crack Movements

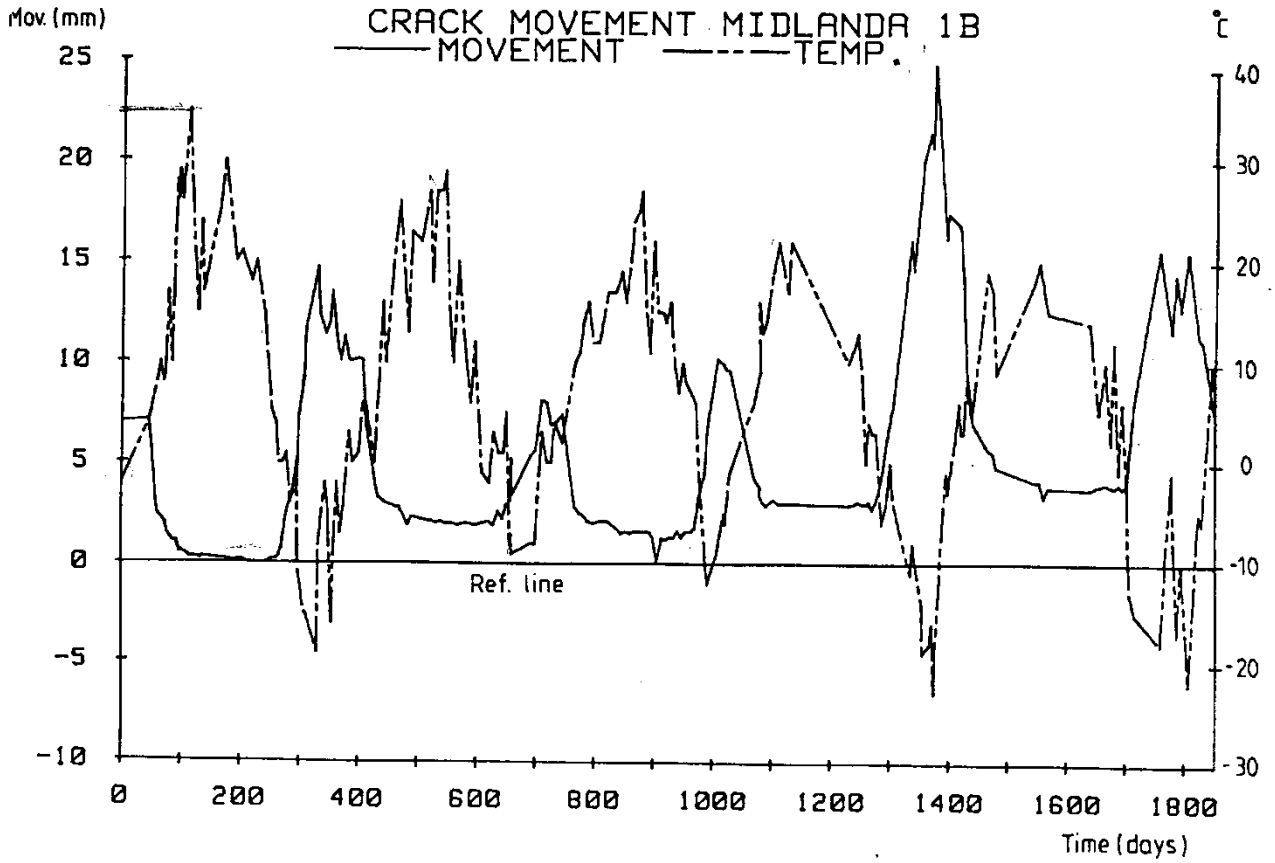


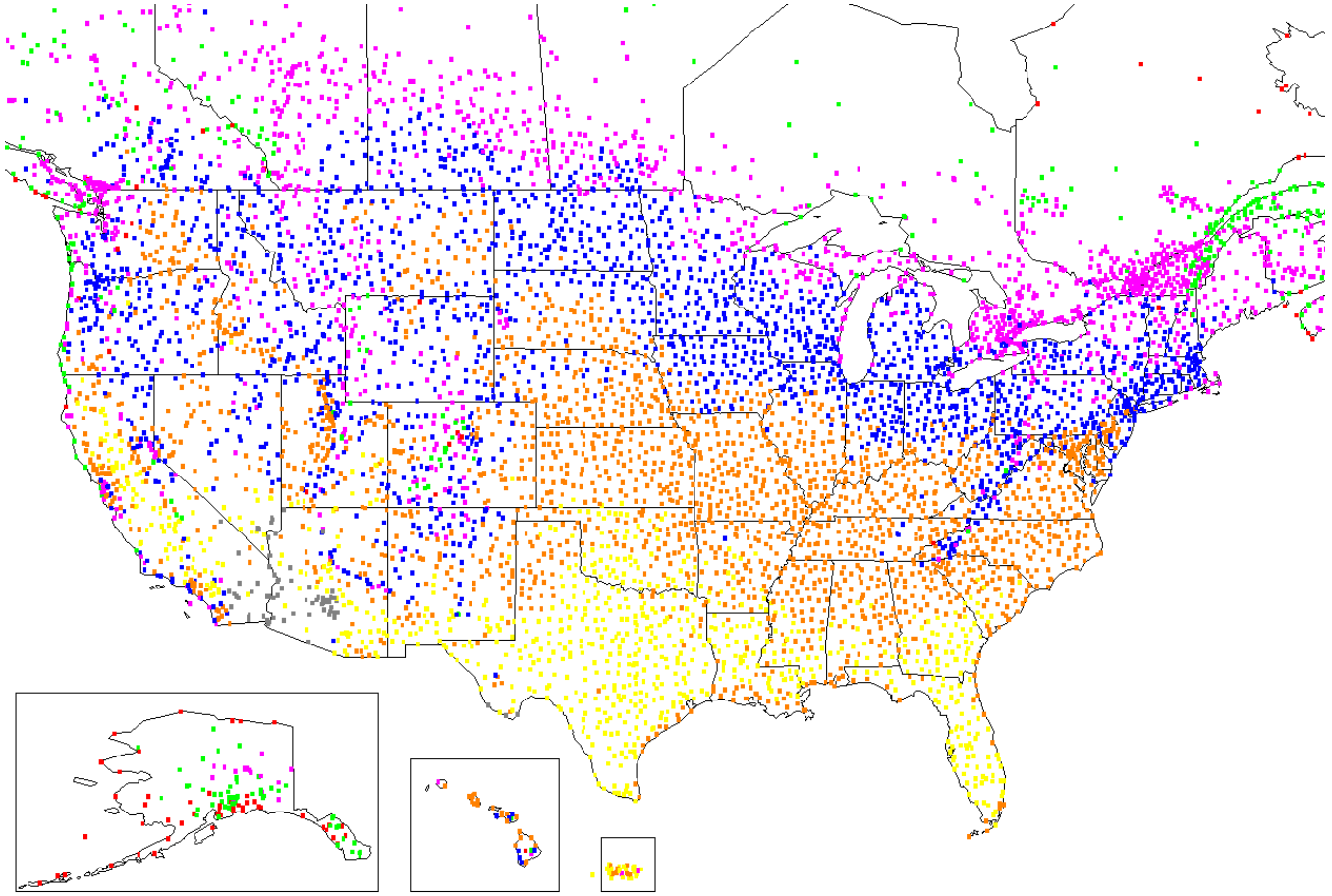
Figure 12 c Crack movement, crack No. 1. pos. 1 B

Step 2 –Temperature Ranges

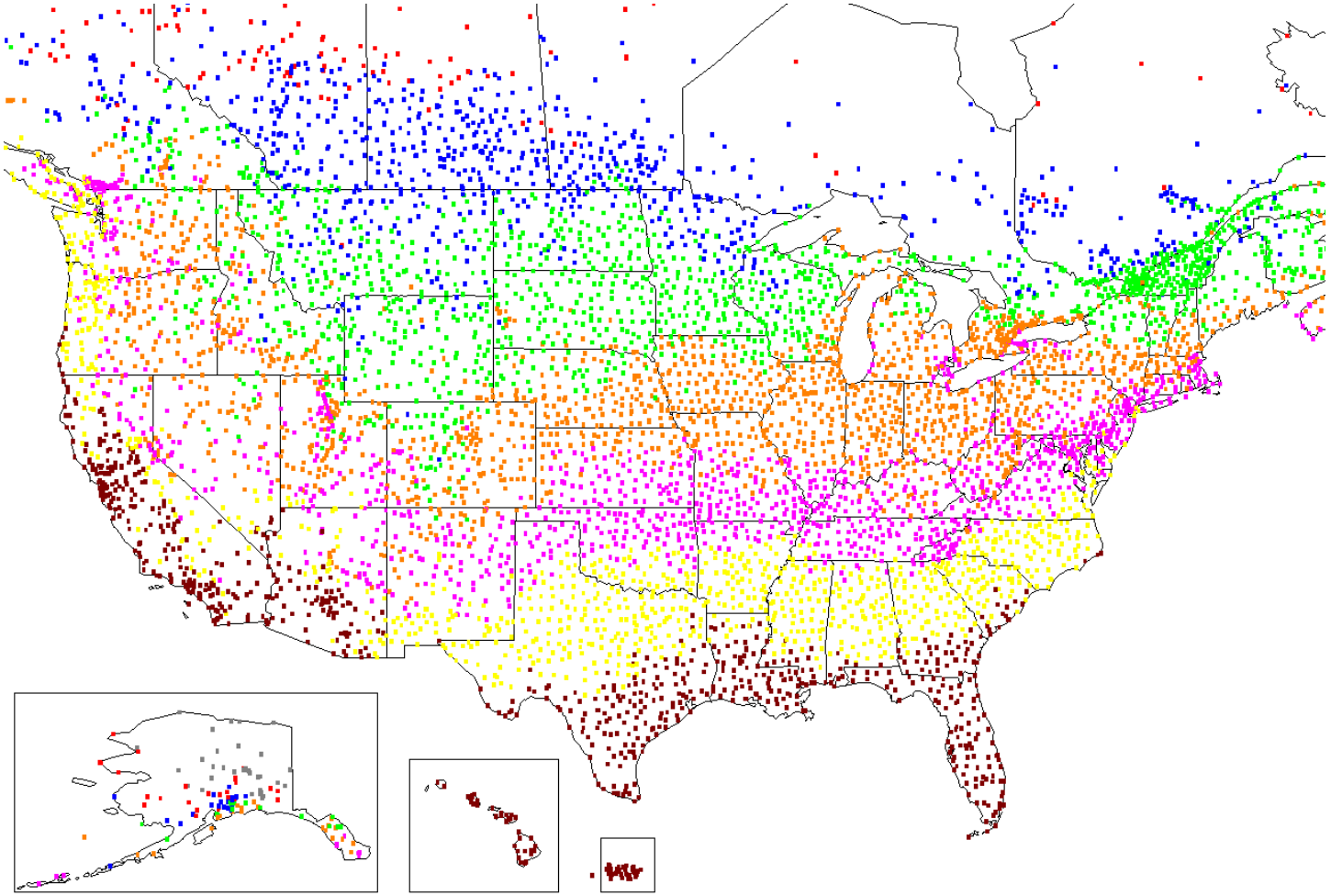
FHWA LTPPBIND can be used for indicating pavement temperatures at a site

- Indicates maximum and minimum pavement surface temperatures, statistically based
- High temperatures 40 to 76°C (98%)
- Low temperatures -10°C to -52°C (98%)

LTPPBIND 98% High



LTPPBIND 98% Low



LTPPBIND 98% TEMPERATURES

STATE	76	70	64	58	52	46	40	-10	-16	-22	-28	-34	-40	-46	-52
Alaska					X	X	X			X	X	X	X	X	X
Arizona	X	X	X	X				X	X	X	X				
California	X	X	X	X	X			X	X	X	X				
Colorado		X	X	X	X	X				X	X	X	X		
Hawaii			X	X				X							
Idaho			X	X	X						X	X	X		
Montana			X	X	X						X	X	X		
Nevada	X	X	X	X				X	X	X	X	X			
New Mexico		X	X	X	X				X	X	X	X			
Oregon			X	X	X	X			X	X	X	X	X		
Utah		X	X	X	X				X	X	X	X			
Washington			X	X	X	X			X	X	X	X			
Wyoming			X	X	X	X					X	X	X		

RMW Pavement Temperatures

- Most states in the Rocky Mountain and West regions have much wider range of climates than most other areas of the US
- Most states in the region need multiple crack treatment materials for different temperature range regions.
- Example California has 5 different sealant specs designed for different LTPPBIND determined temperature range regions.

Step 3 Installation Geometry

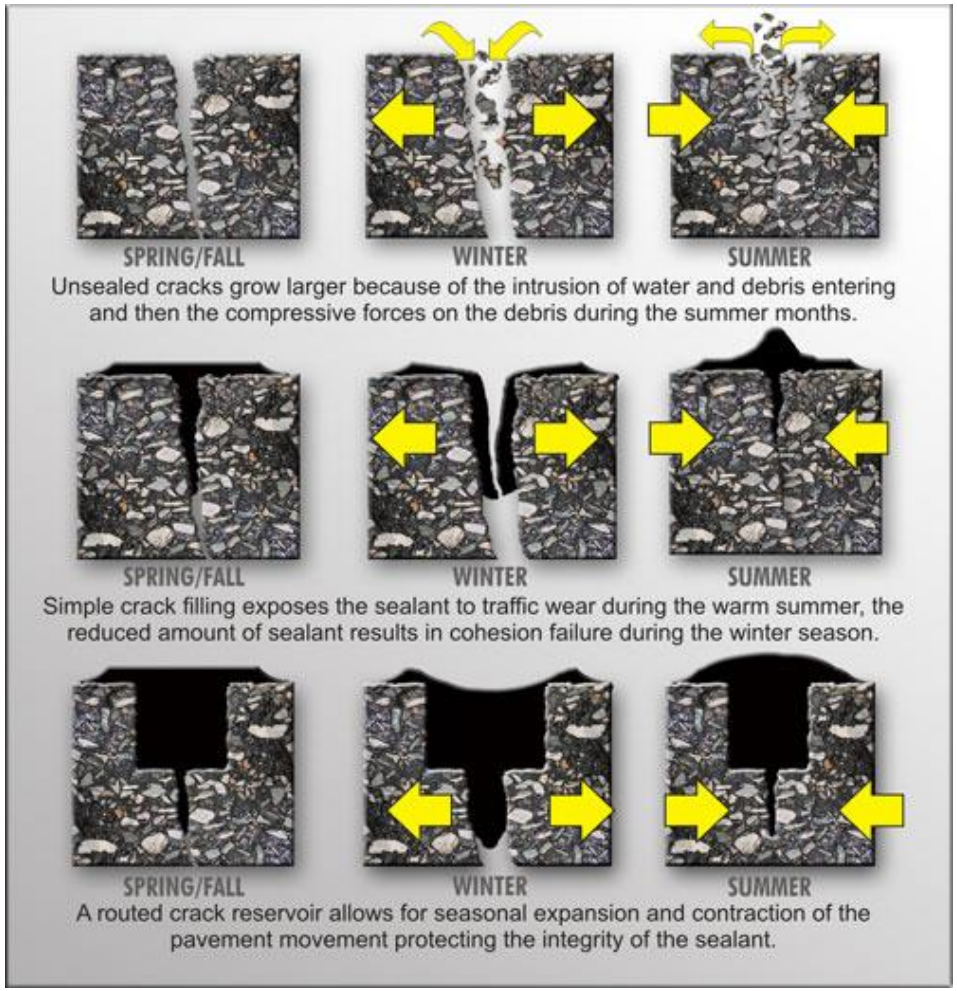
- **Crack Seal Project**

  -Widened reservoir designed to accommodate expected annual crack movements

- **Crack Fill Project**

  -Fill and/or overband the existing crack or install in a reservoir for improved life

Step 3 - Installation Geometry

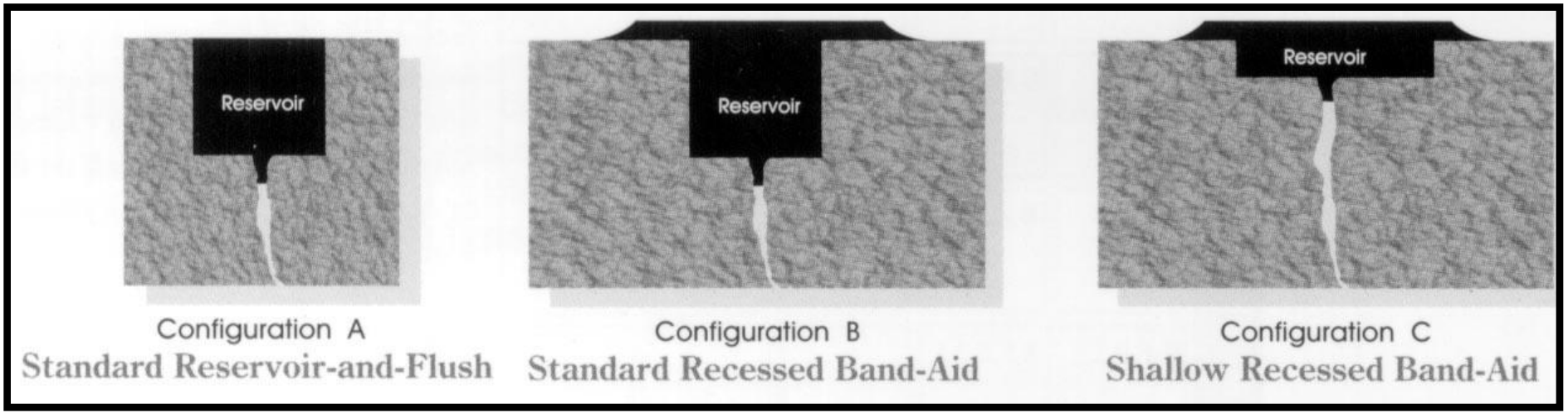


Crack Movement

Crack Fill

Crack Seal

Reservoir Configurations



Step 3-Installation Geometry Selection

Based on LTPPBIND 98% Temperature Range (difference from high to low) Asphalt Grade.

Minimum Reservoir Recommended

Range	Width	Depth
80 C or less	½”	¾”
86°C	¾”	¾”
92°C	1 1/8”	½”
98°C or greater	1½”	3/8”

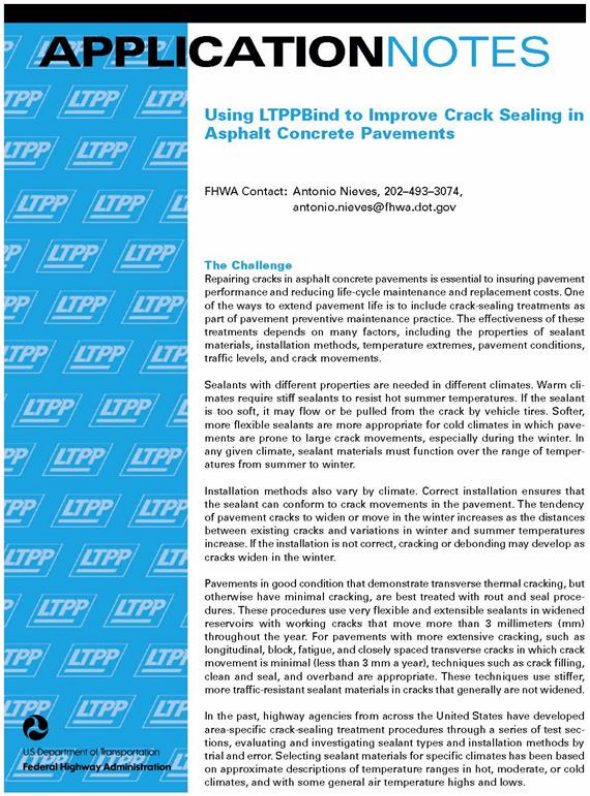
Note: These recommendations are applicable for thermal crack spacing up to approximately 50 to75 feet. For greater spacing, the next wider width can be used for improved results. Reservoir width should not exceed 1½”.

Step 4 Sealant Selection

- Sealing and Filling materials need to resist:
  - High and low temperature extremes
  - Traffic loadings and abrasion
  - Horizontal and vertical movements
  - Aging and water exposure

- Sealant and filler performance is controlled by low temperature, high temperature, adhesive, elastic, and aging properties over the entire range of temperatures and strains experienced.

FHWA RD -03-080 Using LTPPBIND V2.1 to Improve Crack Sealing in Asphalt Concrete Pavements



APPLICATIONNOTES

Using LTPPBind to Improve Crack Sealing in Asphalt Concrete Pavements

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The Challenge

Repairing cracks in asphalt concrete pavements is essential to insuring 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 temperatures 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 distances 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 rout 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 3 mm a year), techniques such as crack filling, clean 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.

U.S. Department of Transportation
Federal Highway Administration

Crack sealants and fillers need to remain functional over the range of anticipated pavement temperatures.

Determine temperature ranges with LTPPBind

www.tfhrc.gov/pavement/ltpp/reports/03080/
www.tfhrc.gov/pavement/ltpp/ppt/bind.ppt
www.fhwa.dot.gov/pavement/ltpp/bind/dwnload

Methods for sealant selection

Low and High Temperature Properties

- Low Temperature
  - Crack Seal- Pass bond – extension test at the determined low temperature 50- 200% extension
  - Crack Fill -- pass mandrel bend at the determined low temperature - approx 10% extension
- High Temperature
  - Crack Seal--Meet D6690 softening point of 80C minimum
  - Crack Fill—minimum 25C above max determined pavement temperature

General Crack Seal Specification Applicability

Low Temperature	Specification Type
• 34, -40, -46 areas	D6690 Type IV & Modified
• -22, -28 areas	D6690 Type II or III
• -16 areas	D6690 Type I,II, or III
• -10 areas	State and Local Specs

Caltrans SSP 37-400

Property	Type 1	Type 2	Type 3	Type 4	Type 5
Softening Point	102C	96C	90C	84C	84C
Flexibility	0C	0C	0C	-11C	-28C
Typical Climate Use	76-10	70-10	64-10	58-16	58-28

Proposed SG Specification

Table B.1. Crack Sealant Performance Grade

Crack Sealant Performance Grade	SG 46	SG 52	SG 58	SG 64	SG 70	SG 76	SG 82
Apparent Viscosity, SC-2	Installation Temperature						
Maximum Viscosity (Pa.s)	3.5						
Minimum Viscosity (Pa.s)	1						
Vacuum Oven Residue (SC-3)							
Dynamic Shear, SC-4	46	52	58	64	70	76	82
Minimum Flow Coeff. (kPa.s)	4						
Minimum Shear Thinning	0.7						
Crack Sealant BBR, SC-5	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4
Maximum Stiffness (MPa)	25						
Minimum Avg. Creep Rate	0.31						
Crack Sealant DTT, SC-6	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4
Minimum Extendibility (%)	85 70 55 40 25 10	85 70 55 40 25 10	85 70 55 40 25 10	85 70 55 40 25 10	85 70 55 40 25 10	85 70 55 40 25 10	85 70 55 40 25 10
Crack Sealant AT, SC-7	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4
Minimum Load (N)	50						

Note: Crack sealant surface energy is provided by manufacturer.

Step 5 Installation

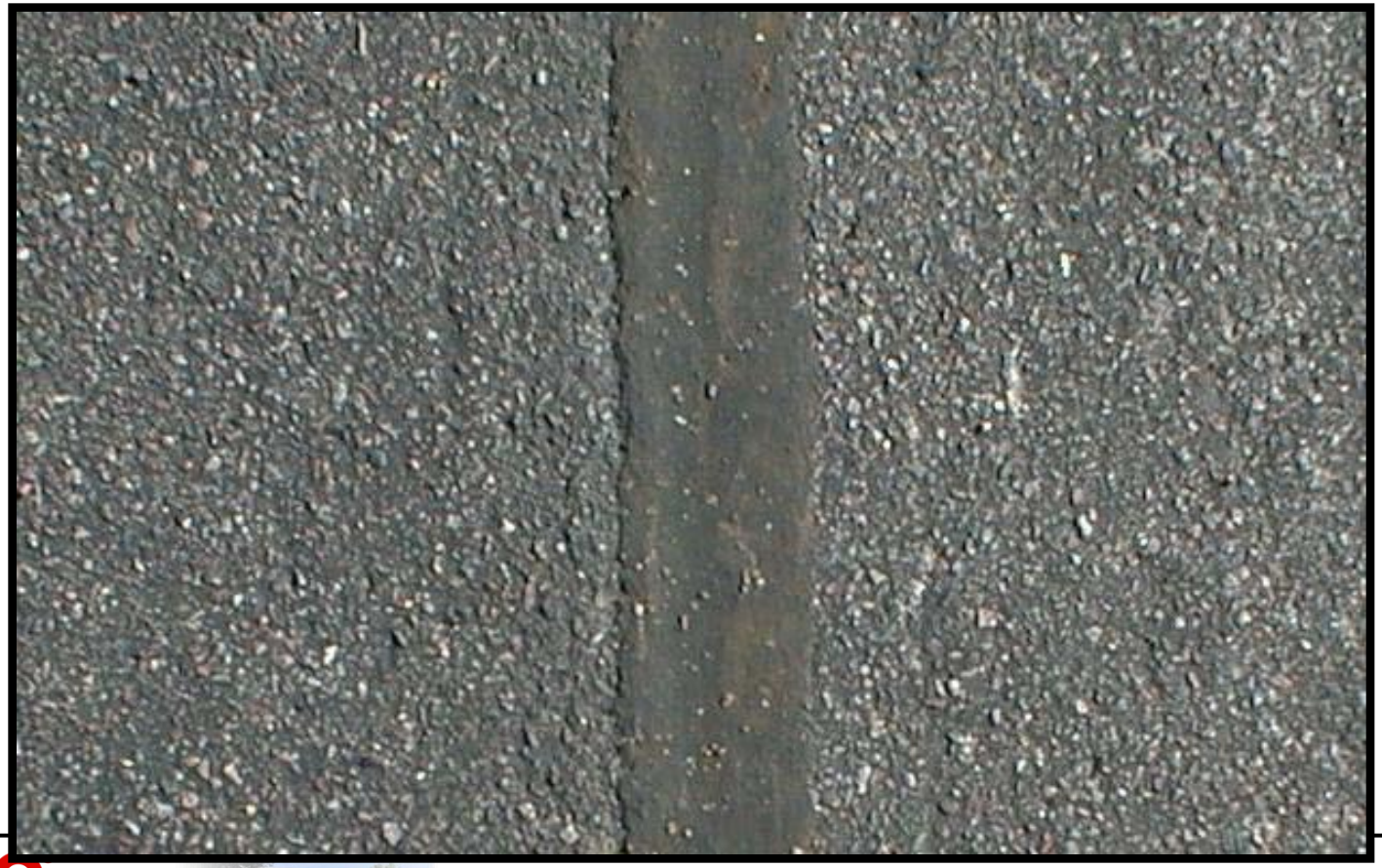
- Weather Conditions – Dry, 40F +
- Sealant Preparation - Proper heating
- Reservoir Cutting - Centered, correct dimensions
- Crack Cleaning - intact, dry, clean
- Finishing Method

Step 5 – Installation- Finishing

Finishing--The final sealant configuration at the pavement surface:

1. **Recess** - approx ¼ in low-*Before Overlay*
2. **Flush Fill** – to surface level -*Squeegee Excess*
3. **Overband Cap** – approx 1/16 in by 2-4 in wide band -*Sealant on top of pavement*

Recommend Overband Appearance (Non-Rout/Clean & Fill)



Meltable Boxless Packaging

- Several versions available
- Must melt quickly and not affect sealant properties
- Less handling - reduces jobsite labor
- No cardboard box to ship, open, handle dispose of


HYDRAULIC OIL
NAPA


CRAFCO
EZ1000

Hot Applied Mastic Repair Materials for Large Cracks

- Flexible
- Water Proof
- Highly Adhesive
- Aggregate Filled
- No Compaction
- Ready for Traffic Quickly
- Good Skid Resistance

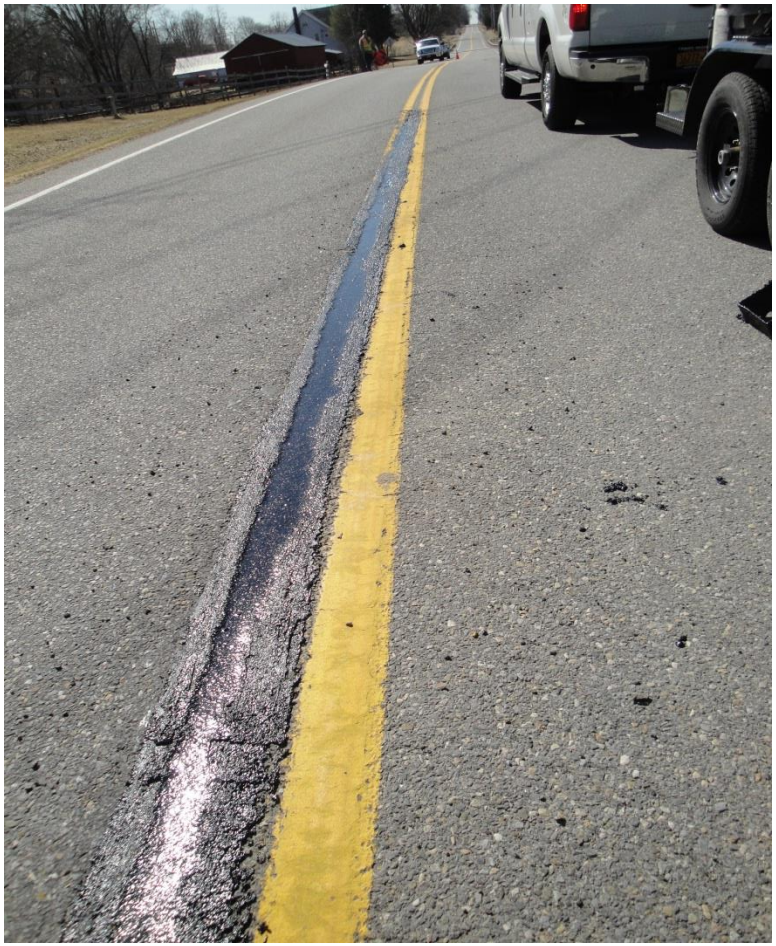
Large Crack Repair

Deteriorated Transverse Crack

Deteriorated Longitudinal Joint

Milling Preparation

Installed Mastic



Depressed Thermal Crack Repair

Driving lane 3 years after application

Pretreatment- Surface Seals

Equipment Innovations

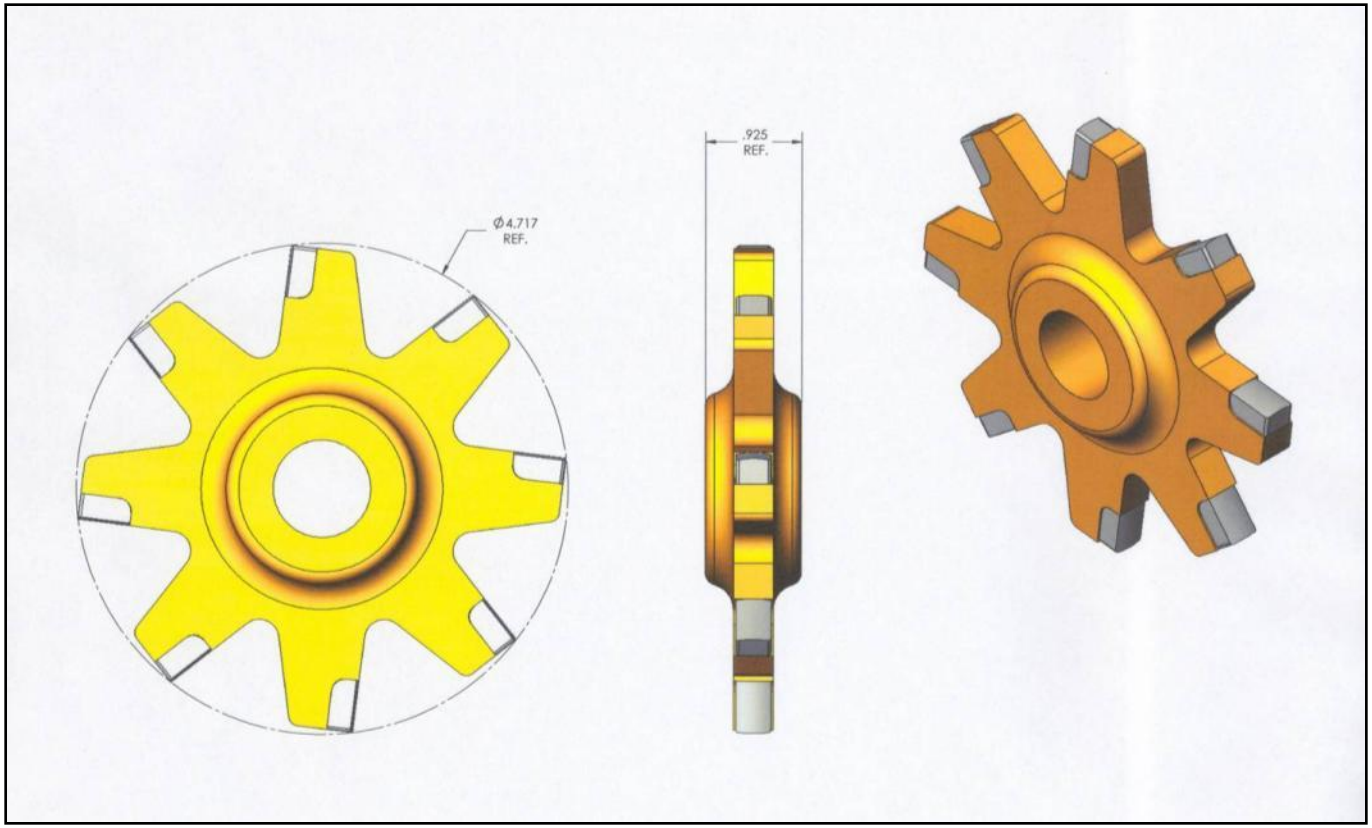
- To make crack sealing easier, faster, more productive, cleaner, more effective
- Crack Cleaning
- Reservoir Cutting
- Heating
- Installation

Melter with Compressor

Vacuum

- Reduces dust
- No post job clean up
- Healthier work environment
- Safer work environment
- PM 10 air regulation compliant

Standard Carbide Cutter



Proper Equipment - Routing

PAVEMENT CUTTER

Proper equipment - Routing

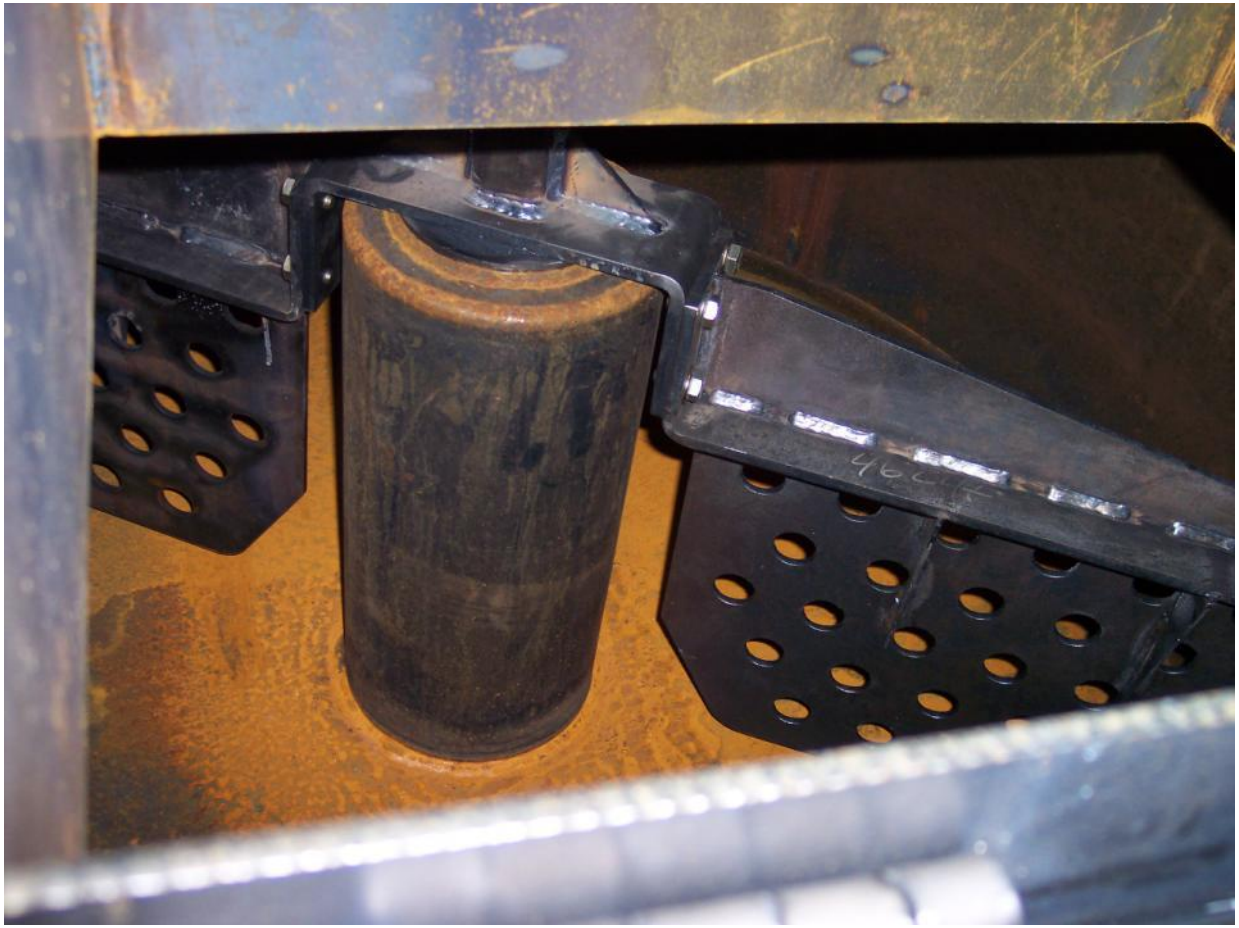
Worn Cutters will not provide a good reservoir.

New Cutter

Worn Cutter

Dust Collection Router

Center Heating System



Swivel Applicator Disk Tip

Melter- Applicator Features

- Loading Conveyors
- Heated Hoses and Wands
- Designed Applicator Tips
- Pump on Demand
- Internal Pumps
- Dual Application System
- Self Propel

Several Innovations are available now that can be used to improve the crack sealing process including

1. Evaluate projects for Seal- Fill
2. Design Installation Geometry
3. Design Sealant Selection
4. Mastics for Large Cracks
5. Equipment Features

THANK YOU !!