Optimizing Crack Treatments

Proper Application Configurations and Material Selection

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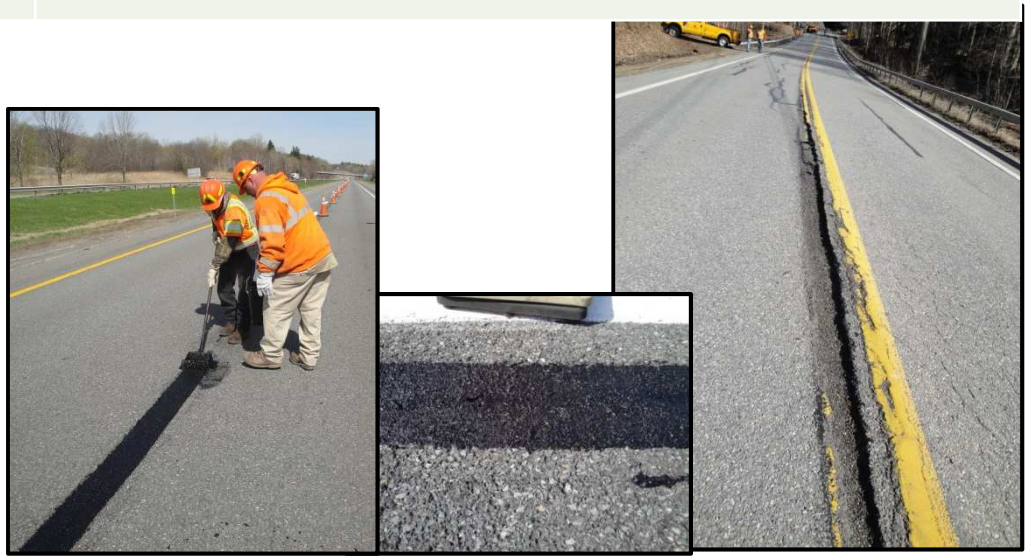
Presentation Objectives

1. Discuss proper application configurations based on treatment and climate ranges
2. Review factors that can influence sealant selection and performance
3. Review sealant specifications and properties, and effects on performance
4. Demonstrate LTPPBind usage

Crack Width

Crack	Crack Width	Crack Density Less than 20%	Crack Density Greater than 20%
Hairline to Large	≤ 1/8” (3mm) – 1 ½” (38mm)	Rout & Seal	Seal Rout to clean, if applicable
Wide	>1 ½” (38mm)	Seal with Mastic	

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



Placement Configuration for Crack Sealing

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.

4 Configuration Variables

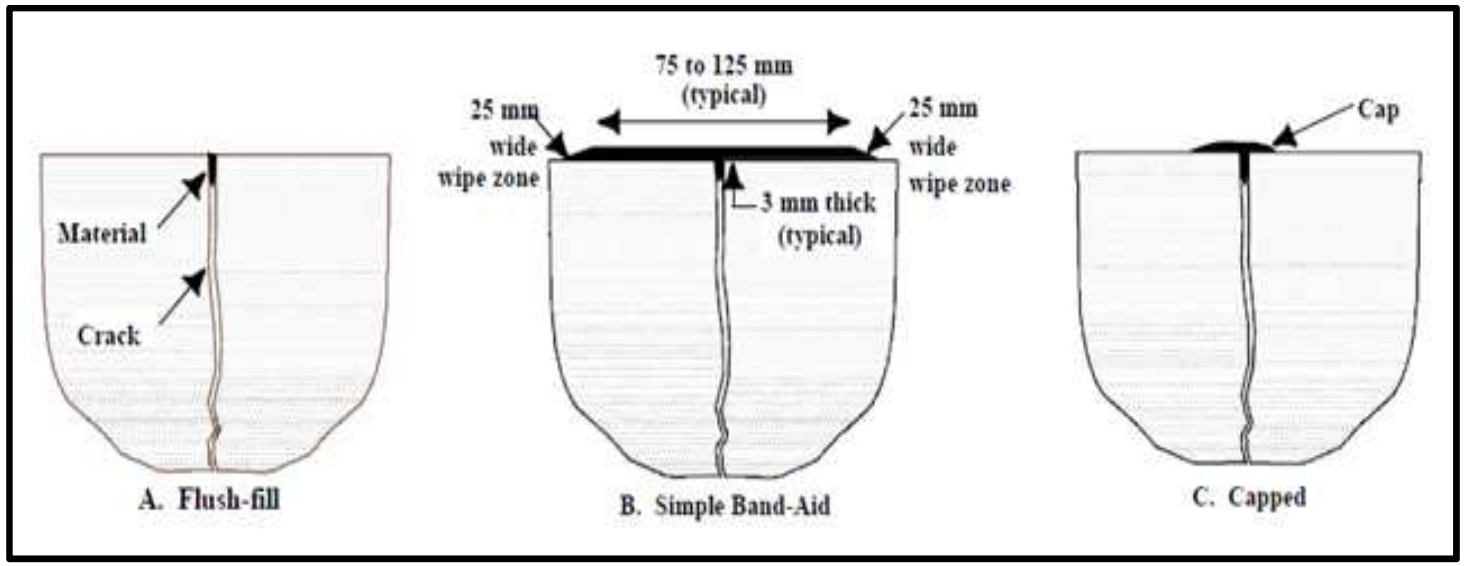
1. Type of Application
2. Type of Reservoir
3. Strike-off or Finishing Characteristic
4. Dimensions of Crack Reservoir and Overband[1]

Placement Configuration for Crack Sealing

4 Categories of sealant placement configuration:

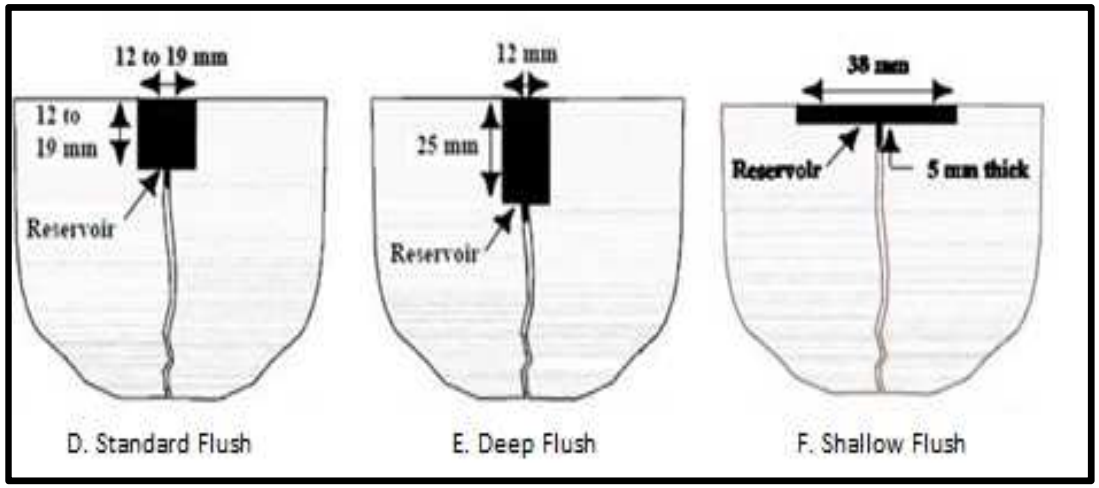
- Flush Fill
- Overband
- Reservoir
- Combination

Placement Configuration for Crack Sealing



- Flush Fill (Figure A)
  - Sealant placed into crack and excess struck off
- Overband Configurations
  - Squeegeed sealant overband (Figure B)
  - Capped overband (Figure C)

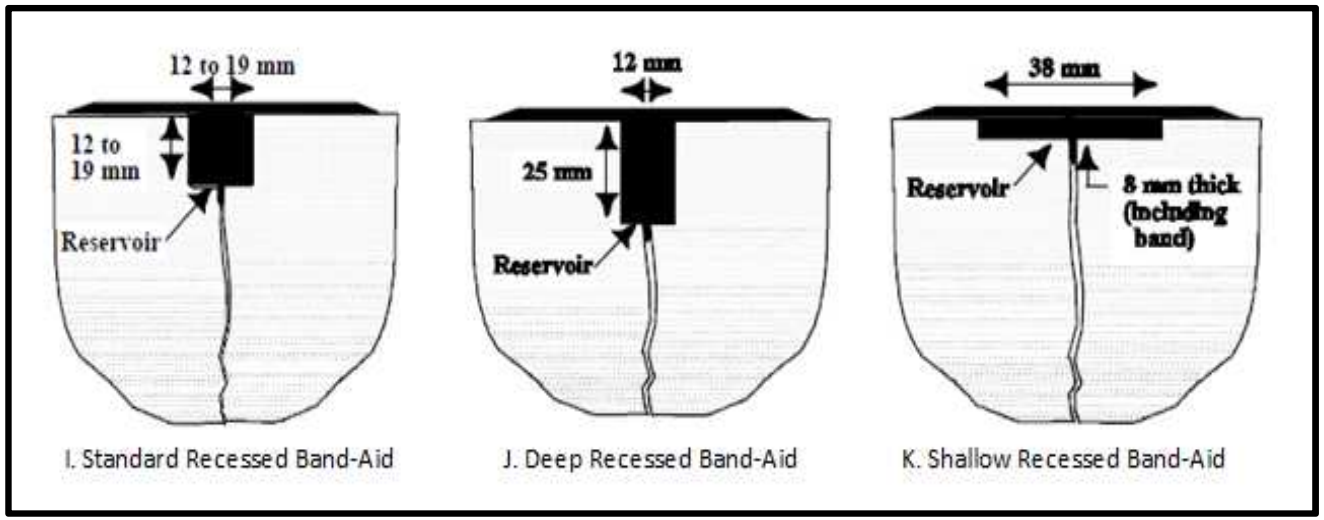
Placement Configuration for Crack Sealing



Reservoir Configurations

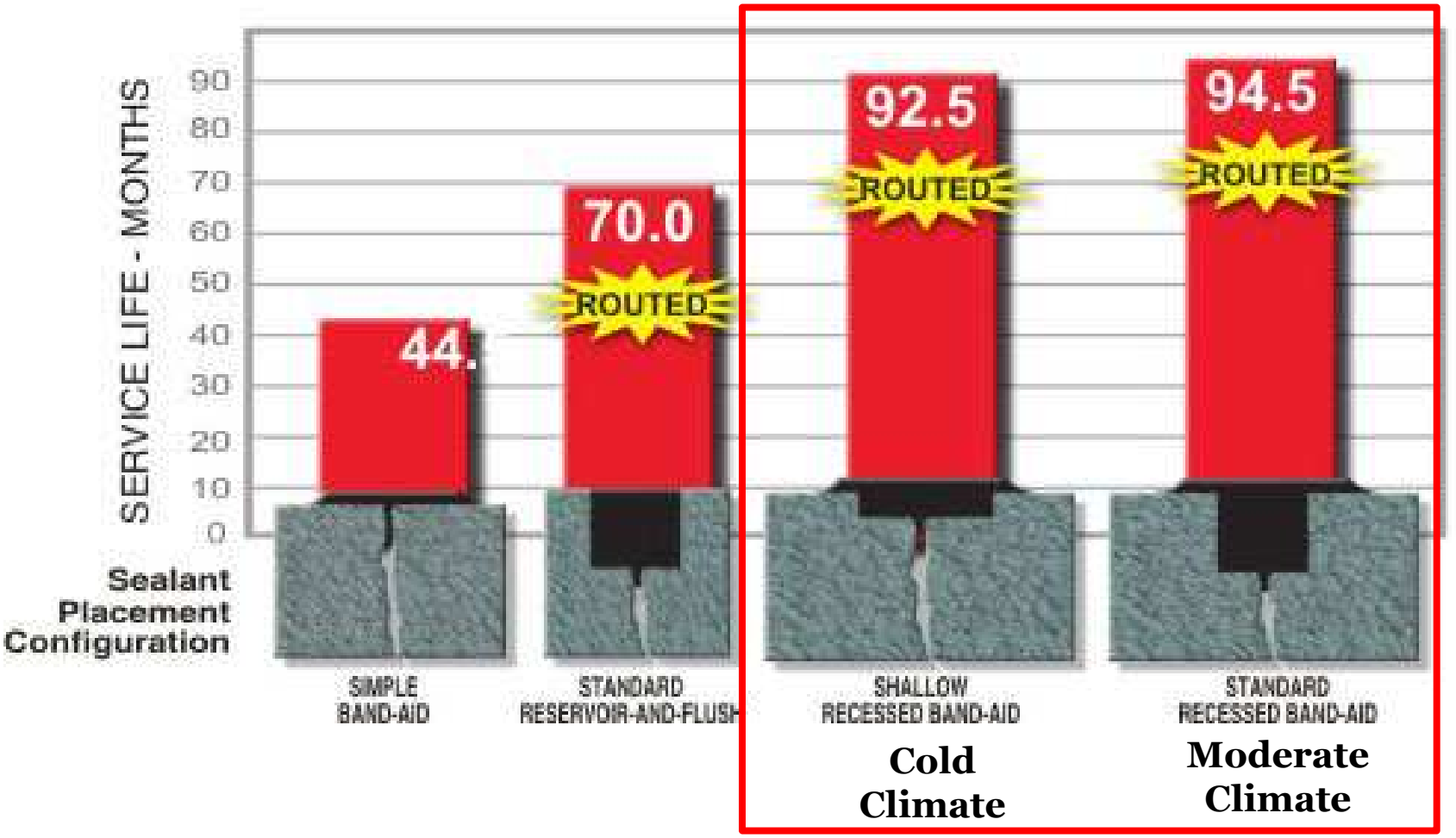
- Reservoir with Flush Fill
- Reservoir with Recess Fill

Placement Configuration for Crack Sealing



- Combination Configurations
  - Designed Reservoir
  - Material placed into and over the reservoir
  - Material shaped into an overband with squeegee
  - Overband centered over crack reservoir

Reservoir Design Dimensions



Reservoir Design Dimensions

- LTPPBIND – Used for Superpave binder selection to reduce rutting, fatigue and thermal cracking
  - Determined by LTPP project that included pavement temperatures in U.S. and Canada
  - Download free program at http://www.fhwa.dot.gov/research/tfhrc/programs/infrastructure/pavements/ltpp/install.cfm
- Select reservoir dimensions and sealant based on climate for best performance

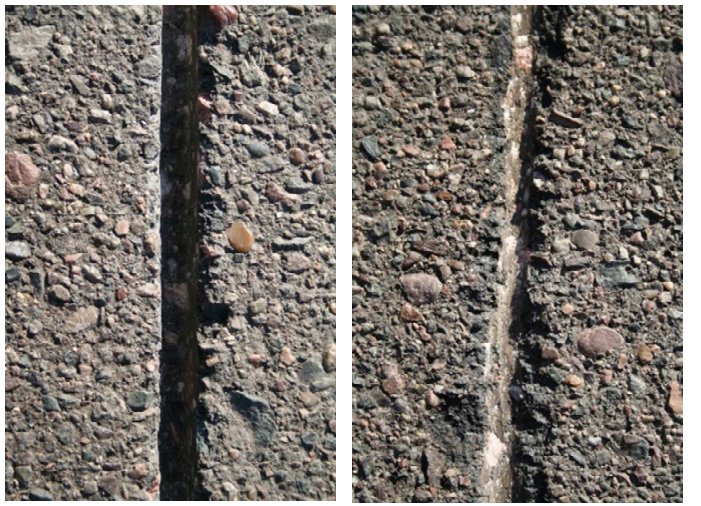
Climate	Location	7- Day Avg. Pavement Temperature (98% reliability)				PG Grade	Temperature Difference	Reservoir Width (max)	Reservoir Depth (max)
		High (F)	High (C)	Low (F)	Low (C)				
Extreme Cold	Fairbanks, AK	117	47.3	-56	-48.9	PG 52-52	≥ 98°C (208°F)	38 mm (1 1/2")	12 mm (1/2")
Very Cold	Mildred, ND (Miles City, MT) (Worland, WY)	138	58.9	-31	-34.8	PG 64-40	≥ 98°C (208°F)	38 mm (1 1/2")	12 mm (1/2")
Cold	Omaha, NE (Denver, CO) (Boise, ID)	137	58.3	-12	-24.4	PG 64-28	≤ 92°C (198°F)	28 mm (1 1/8")	12 mm (1/2")
Moderate	Washington, DC (Nashville, TN) (St. Louis, MO)	139	59.2	9	-13.0	PG 64-22	≤ 86°C (187°F)	19 mm (3/4")	19 mm (3/4")
Hot	Laredo, TX; (Phoenix, AZ) (Riverside, CA)	148	64.7	25	-3.7	PG 70-10	≤ 80°C (176°F)	12 mm (1/2")	19 mm (3/4")
Coastal	San Diego, CA (Miami, FL) (Atlanta, GA)	133	56.3	33	.4	PG 58-10	≤ 80°C (176°F)	12 mm (1/2")	19 mm (3/4")

Routing

Workmanship Is Vital - Steps To Ensure Successful Routing

- Begin routing:
  - Rout at least 3 mm (⅛”) from each crack face
  - Keep centered over crack
  - Ideal channel based on LTPPBind
  - STOP if excessive spalling occurs (> 38 mm (1 ½”)) and check equipment and pavement

Good Rout



Poor Rout

Good Rout and Seal

Factors Influencing Sealant Selection

- Project Factors
- Climate Factors
- Pavement Factors
- Installation Factors

Project Factors

- Specifications
- Approvals/QPL/ Acceptance procedures
- Availability/ Lead Times
- Personal Preferences
- Product Cost
- Competition
- Project Goals/ Expectations

Climate

- Location High Temperatures
- Location Low Temperatures
- Installation time of the year
- Precipitation ????
- Maintenance Methods (Climate related)????

Pavement Factors

- Pavement Type - AC or PCC, or Composite
- Crack or Joint Types- Longitudinal, transverse, fatigue, etc
- Crack or Joint Spacing
- Expected movement
- Crack Seal or Crack Fill project
- Future maintenance-overlays, surface treatments
- Traffic- speed, loads, volume, parking lot, foot
- Crack/joint width
- Slopes / super elevation

- **Not an exact singular answer**
  - Cracks move an amount determined by spacing, temperature change, and thermal coefficient of expansion, just as any other material does.
  - In very cold climates, there are documented movements up to 25,4 mm, with 30,5 meter spacing, and 12,5 mm movement with 15,25 meter spacing
  - Maximum amount of movement in the most extreme climates is approx. 2,54 mm for each 3 meter spacing.
  - There are other movements than thermal, mainly subgrade shrinkage in some areas, that can increase thermal movement

Installation/Construction

- Melter Type
- Cleaning Methods
- Installation Configuration
- Contractor Experience
- Traffic Control

Sealant Property Effects on Performance

- Sealant material performance is controlled by low temperature, high temperature, adhesive, and elastic properties over the entire range of temperatures and extensions encountered during use

  To perform adequately, sealant must remain functional over the entire range of temperatures and extensions experienced

- To rationally select sealant, one must know high and low temps and movements that will be experienced, and sealant properties at these temps and movements

Sealant Properties Influencing Selection

- Low Temperature stiffness, extension, flexibility
- High Temperature stiffness, tracking resistance
- Elasticity
- Application Temperature flowability
- Adhesion

Low Temperature Properties

- Bond Tests
  - extension capability while maintaining adhesion at -7C, -18C,-29C
  - 50%, 100%, 200% extension
- Mandrel Bend/Flexibility
  - Flexibility at -1C, -7C, -18C, -29C, -34C
  - Provides approximately 10% extension

High Temperature Properties

Softening Point- melting temperature

- 80 C° min ASTM D6690 (Reservoir)
- 14 C° min above max pavement temperature (Overbands)

Flow at 60C° – D6690

3 or 5 mm max at 60C°

High Temp Penetration- 49C°- 82C°

-Max approx. 250 at max pavement temperature

Elasticity

- **Resilience ASTM D6690**
  - 60% min Type II, III, IV Joint Sealing
  - 30%-60% State specs– Crack Sealing
  - Lower resilience - lesser tendency for adhesion loss during extension, all else being equal
    - Putty vs rubber band

Application Temperature Flowability

Viscosity- generally rotational Brookfield type

Very Flowable, Very self leveling -- <1500 cp

Superflex, DF, Superstretch

Self Leveling - - 1500-4000 cp

200, 211,221,515, 102, 103

Moderate High - - 4,000-10,000 cp

201, AR+, Polyflex, 102GL18B, 180

High - - 10,000cp - 15,000 cp

233, 5078TXA, High Fiber materials

Adhesion

- **Bond Tests**
  - Indicates adhesion and extensibility at low temperatures
- **Tensile Adhesion**
  - Indicates adhesion and extensibility at 23C

LTPPBIND

- LTTPPBIND is a system developed for the paving asphalt industry to assist in selecting the appropriate grade of asphalt cement for asphalt concrete pavements.
- LTTPBIND determines both high and low pavement temperatures for a given project location based on weather data and modeling
- Grades determined in 6 C increments with the high followed by the low ex 64-22 58-28
- Temperatures determined at the surface or at depth
- Temperatures determined at 50% or 98% reliability
- Can be used to help with sealant selection

FHWA APPLICATION NOTES

- Using LTPPBIND V2.1 to Improve Crack Sealing in Asphalt Concrete Pavements
- Published Dec 2003
- Explains how LTPPBIND can be used to assist with selection of sealant materials.

LTTPBind V2.1

APPLICATIONNOTES

Using LTPPBind V2.1 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

LTTPBind V2.1

Table 1. Summary of 98-Percent Reliability Rates from LTPPBind Measured at the Fairbanks, AK, International Airport Weather Station.

Latitude, degree	64.82	
Depth to surface of layer, mm	0	
Desired reliability, percent	98	
Traffic loading, million ESAL	0	
Traffic speed	Fast	
Method for adjusting for traffic	Strategic Highway Research Program	
Pavement temperature and pavement grade	High	Low
Design air temperature, °C	27.8	-45.0
Design air temperature standard deviation	1.8	3.6
Using HT/LT model: LTPP/LTPP	High	Low
Design pavement temperature, °C	47.3	-48.9
Adjustment for traffic loading	+0	
Adjustment for traffic speed	+0	
Adjusted pavement temperature, °C	47.3	-48.9
Selected binder grade	52	-52

Although these descriptions help with product selection, a more efficient method of identifying temperature ranges and climate applicability to select pavement crack-sealing materials is needed.

The Solution

The Federal Highway Administration's Long-Term Pavement Performance (LTPP) program originally developed the software program LTPPBind to help highway agencies select the most suitable and cost-effective Superpave® asphalt binder performance grade for a particular site. LTPPBind determines both high and low pavement temperatures for a given project location. Normally, temperatures from LTPPBind are used to determine the grade classification of asphalt cement used for asphalt concrete paving.

High and low temperature grades are determined in 6 °Celsius (C) increments, with highs ranging from 40 to 76 °C and lows ranging from -46 to -10 °C. Temperatures can be determined at the surface or at a depth in the pavement, and because temperatures are never the same from year to year, they can be selected by the designer to provide either a 50- or 98-percent reliability.

Sealant manufacturers quickly realized that crack-sealing materials in any given climate would be exposed to and would need to function within the same pavement temperatures that LTPPBind identifies. The temperature grade range (difference between temperature highs and lows) that LTPPBind determines also helps predict the amount of thermal-induced crack widening as the pavement cools from summer to winter. LTPPBind, therefore, can help highway agencies select the appropriate crack-sealing materials and procedures for different climates and conditions.

Tables 1 and 2 show 98-percent reliability rates from LTPPBind for Fairbanks, AK (an extremely cold climate), and Laredo, TX (a hot climate). Table 3 summarizes high and low pavement temperatures and temperature ranges for these two climates as well as several other more moderate climates.

The information in table 3 shows that high pavement temperatures differ by as much as 18 °C, ranging from 47 °C in Fairbanks, AK, to 65 °C in Laredo, TX. Low temperatures, however, vary much more, from a low of -49 °C in Fairbanks, AK, to 0.4 °C in San Diego, CA—a difference of 50 °C.

The range of high-low pavement temperatures in a specific climate also varies, with as much as a 96 °C variation in temperature in Fairbanks, AK, to as little as a 56 °C temperature variation in San Diego, CA. In general, moderate coastal climates have the smallest differences between summer and winter temperatures, and therefore have the narrowest range of high and low pavement temperatures. The 56 °C range in San Diego, CA is typical of these areas.

This pavement temperature information helps determine crack-sealing procedures and materials. For example, crack-sealing products in Fairbanks, AK, will need to resist high temperatures of 47 °C and remain flexible down to -49 °C, and the material and installation configuration must accommodate the movement of cracks that results from a 96 °C drop in pavement temperature.

The extent to which cracks widen depends more on the differences in pavement temperature than the temperature itself. For example, temperatures in Mildred, ND, are 12 to 14 °C higher than in Fairbanks, AK, but the temperature range, at 94 °C, is very similar to the range in Fairbanks. Therefore, pavement cracks in Mildred should experience about as much movement as those in Fairbanks. In comparison, the temperature ranges in Omaha, NE, and Washington, DC, are 83 °C and 72 °C, respectively, so

LTTPBind V2.1

there will be less pavement crack expansion in Omaha than in Mildred or Fairbanks, and even less expansion in Washington, DC.

Laredo, TX, in contrast, has a high pavement temperature of 65 °C and a low pavement temperature of -4 °C—a 69 °C range. In this climate, crack sealants must tolerate hot pavement temperatures and must remain workable only to -4 °C, which is quite different than the requirements for sealants in Fairbanks, AK.

Using LTPPBind to Select Crack-Sealing Materials

Typical specifications for crack-sealing materials include sealant property evaluations at high, moderate, and low temperatures. The evaluations provide some information on materials characteristics at those temperatures. Using LTPPBind, sealant properties at anticipated high and low temperatures can be evaluated or compared.

Low Temperature Properties

Sealants that meet the American Society for Testing and Materials (ASTM) D6690-Type I (ASTM D1190) are evaluated for low temperature bond at -18 °C using 5 cycles of 50-percent extension. This -18 °C temperature exceeds the -16 °C LTPPBind temperature grade, which indicates that these materials can function at -16 °C. D6690 Type II (ASTM D3405) sealants are tested for bond using 3 cycles of 50-percent extension at -29 °C, which exceeds the -28 °C LTPPBind temperature grade, indicating functioning at -28 °C. ASTM D6690 Type IV (low modulus D3405) sealants are evaluated for bond at -29 °C, but with 200-percent extension. These materials typically will pass 50- or 100-percent bond tests at temperatures as low as -40 °C. These types of sealants are used most often in -34 °C or -40 °C LTPPBind-rated climates.

Flexibility or mandrel bend testing also is performed commonly on materials that are used to treat and fill nonworking cracks. Test procedures vary somewhat, but ASTM D3111 with a 25-mm diameter mandrel and a 10-second bend time is typical. Even though these crack types typically do not move as much as thermal transverse cracks, the selected materials should not become brittle at low temperatures for the climate. Common flexibility test temperatures are -7, -12, -18, -29, and -34 °C. These temperatures are similar to the LTPPBind grades

Table 2. Summary of 98-Percent Reliability Rates from LTPPBind Measured at the Laredo, TX, International Airport Weather Station.

Latitude, degree	27.53	
Depth to surface of layer, mm	0	
Desired reliability, percent	98	
Traffic loading, million ESAL	0	
Traffic speed	Fast	
Method for adjusting for traffic	Strategic Highway Research Program	
Pavement temperature and pavement grade	High	Low
Design air temperature, °C	39.8	-2.7
Design air temperature, standard deviation	.8	2.7
Using HT/LT Model: LTPP/LTPP	High	Low
Design pavement temperature, °C	64.7	-3.7
Adjustment for traffic loading	+0	
Adjustment for traffic speed	+0	
Adjusted pavement temperature, °C	64.7	-3.7
Selected binder grade	70	-10

Table 3. Grade Summary Based on 98-Percent Reliability Rates from LTPPBind Temperatures for Various Climates.

Climate Description	Location	High	Low	Range	Grade
Extreme Cold	Fairbanks, AK	47.3	-48.9	96.2	52–52
Very Cold	Mildred, ND	58.9	-34.8	93.7	64–40
Cold	Omaha, NE	58.3	-24.4	82.7	64–28
Moderate	Washington, DC	59.2	-13.0	72.2	64–16
Hot	Laredo, TX	64.7	-3.7	68.4	70–10
Coastal	San Diego, CA	56.3	0.4	55.9	58–10

98% Pavement Temperatures, °C

LTTPBind V2.1

Table 4. Suggested Sealant Reservoir Configurations for Crack Sealing of Working Cracks for Various LTPPBind Temperature Ranges.

LTPPBind—98% Grade Range	Minimum Reservoir Width (mm)	Reservoir Depth (mm)
80 °C or less	12	19
86 °C	19	19
92 °C	28	12
98 °C or greater	40	12

of -10, -16, -28, and -34 °C. Passing results indicate that the material in question can be used successfully in nonworking cracks in climates with those low temperatures.

High Temperature Properties

Standard measurements of sealant properties at high temperatures do not correspond to LTPPBind temperatures as well as sealant properties at low temperatures. Tests that provide some indication of high temperature properties include ASTM D5329 cone penetration testing at 25 and 60 °C and ASTM D36 softening point testing. ASTM D6690 Type I and II products have penetration limits of 90 dmm maximum at 25 °C and typically are used in climates that do not exceed 64 °C. ASTM D6690 Type IV materials have penetration limits of 150 dmm maximum, and generally are used in climates with temperatures as high as 58 °C. In hot climates, (70 °C or higher), low penetration products, such as those less than 40 dmm are required. For filling in hot climates, softening points above 90 or 100 °C commonly are specified.

Sealant Product Classification

Based on testing evaluations and past experience in various climates, sealant materials can be classified or rated according to LTPPBind high and low temperature determinations. For example, materials that meet ASTM D6690 Type I (ASTM D1190) can be classified as 64–16 sealants, and ASTM D6690 Type II materials can be classified as 64–28 sealants. This means that they can be used in climates with temperatures as high as 64 °C and can function at -16 °C or -28 °C, respectively, in bond testing.

Similarly, the softer ASTM D6690 Type IV materials can be classified as 58–34 or 58–40 sealing materials, because they can pass bond tests at -34 or -40 °C, and typically are used successfully in -34 or -40 °C low temperature graded climates. Accordingly, sealant suppliers can develop and identify products that are appropriate for different climates by using the LTPPBind temperature guidelines.

Reservoir-Widening Guidelines

As discussed above, the extent of thermal crack movement depends on crack spacing and temperature range. The LTPPBind temperature range gives a general indication of expected crack movement, with greater movements occurring in climates with more extreme temperature ranges. In general, wide reservoirs are required for successful sealant performance with thermal transverse cracks in cold climates. In very cold climates (-34 °C and below), wide, shallow reservoir configurations (40 x 12 mm) have yielded the best performance. In -22 to -28 °C climates, narrower, 19 x 19 mm reservoirs usually work well. Suggested reservoir configurations for crack sealing (working cracks) based on LTPPBind grade range determinations are shown in table 4.

LTPPBind Application Benefits

Temperature grade guidelines from LTPPBind should be used to evaluate and develop sealant properties and specifications. The program's ability to determine high and low pavement temperatures can provide insight into the conditions that crack-sealing treatments will be subjected to in the field. Sealant material properties can be evaluated at different temperatures, and sealants can be classified according to their effectiveness at various LTPPBind temperature ranges.

An improved understanding of pavement temperatures and corresponding material properties helps highway agencies determine the sealant materials and installation methods that provide the best results. Using LTPPBind to design and select crack-sealing treatments will help improve pavement performance, ensure longer-lasting treatments, reduce repairs, and decrease life-cycle costs.

For More Information

For more details on applying LTPPBind to crack sealing, contact Antonio Nieves, 202–493–3074, antonio.nieves@fhwa.dot.gov.

RoadSaver 221

Sealing 64-28
Filling 64-34

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PRODUCT DATA SHEET

ROADSAVER 221

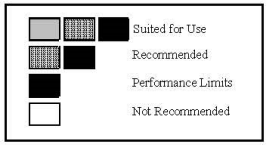
PART NO. 34221

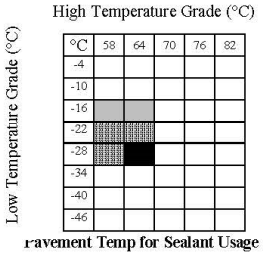
DECEMBER 2011

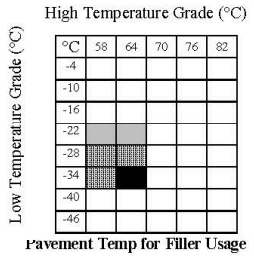
READ BEFORE USING THIS PRODUCT

GENERAL Crafco RoadSaver 221 sealant is a hot-applied asphalt based product used to seal and fill cracks and joints in asphalt or portland cement concrete pavements in moderate to cold climates. RoadSaver 221 is supplied in solid form which when melted and properly applied forms a resilient, adhesive and flexible compound that resists cracking in the winter and is resistant to flow and pick-up at summer temperatures. RoadSaver 221 is used in highway, street, and airfield pavements and is applied to pavement cracks and joints using either pressure feed melter applicators or pour pots. At application temperature RoadSaver 221 is a free flowing, self-leveling product. RoadSaver 221 is a widely used, excellent performing sealant that has been a quality Crafco product for 25 years. VOC = 0 g/l.

USAGE GUIDELINES RoadSaver 221 pavement temperature performance limits are 64-28 for crack sealing and 64-34 for crack filling. Usage recommendations are shown in Crafco pavement temperature grade charts shown at the right. Refer to Crafco Product Selection Procedures to determine sealant or filler use and pavement temperature grades.







SPECIFICATION CONFORMANCE RoadSaver 221 meets all requirement of ASTM D6690 (AASHTO M324), Type II, "Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavements", (formerly ASTM D3405 and AASHTO M301). It also exceeds requirements of ASTM D6690 (AASHTO M324), Type I, (formerly ASTM D1190, AASHTO M173), and Federal Specification SS-S-164.

Test	ASTM D6690 (AASHTO M324) Type II Spec. Limits
Cone Penetration	90 max.
Flow	3mm max.
Softening Point	176°F (80°C) min.
Resilience	60% min.
Bond, -20°F (-29°C), 50% ext.	Pass 3 cycles
Asphalt Compatibility	Compatible
Minimum Application Temperature	380°F (193°C)
Maximum Heating Temperature	400°F (204°C)

INSTALLATION The specific gravity of Crafco RoadSaver 221 is 1.26 at 60°F. Prior to use, the user must read and follow Installation Instructions for Hot-Applied RoadSaver, PolyFlex, Parking Lot and Asphalt Rubber Products to verify proper product selection, heating methods, pavement preparation procedures, application geometry, usage precautions and safety procedures. These instructions are provided with each pallet of product.

PACKAGING Packaging consists of individual boxes of product which are palletized into shipping units. Boxes contain a non-adherent film which permits easy removal of the product. Each pallet contains 72 boxes which are stacked in six layers of 12 boxes per layer. The weight of product in each box does not exceed 40 lbs. (18kg) and pallet weights do not exceed 2,880 lbs. (1310kg). Pallets of product are weighed and product is sold by the net weight of product. Product boxes are manufactured from double wall kraft board producing a minimum bursting test certification of 350 psi (241 N/cm^2) and using water resistant adhesives. Boxes use tape closure and do not contain any staples. Boxes are labeled with the product name, part number, lot number, specification conformance, application temperatures and safety instructions. Palletized units are protected from the weather using a three mil thick plastic bag, a weather and moisture resistant cap sheet and a minimum of two layers of six month u.v. protected stretch wrap. Pallets are labeled with the product part number, lot number and net weight. Installation Instructions are provided with each pallet in a weather resistant enclosure.

WARRANTY CRAFCO, Inc. warrants that CRAFCO products meet applicable ASTM, AASHTO, Federal or State specifications at time of shipment. Techniques used for the preparation of the cracks and joints prior to sealing or filling are beyond our control as are the use and application of the products; therefore, Crafco shall not be responsible for improperly applied or misused products. Remedies against Crafco, Inc., as agreed to by Crafco, are limited to replacing nonconforming product or refund (full or partial) of purchase price from Crafco, Inc. All claims for breach of this warranty must be made within three (3) months of the date of use or twelve (12) months from the date of delivery by Crafco, Inc. whichever is earlier. There shall be no other warranties expressed or implied. **For optimum performance, follow Crafco recommendations for product installation.**

CRAFCO® INC
AN ERGON COMPANY

Polyflex Type III

Filling 70-4

CRAFCO INC
AN ERGON COMPANY
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www.crafco.com

PRODUCT DATA SHEET

POLYFLEX TYPE 3

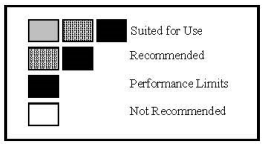
PART NO. 34521

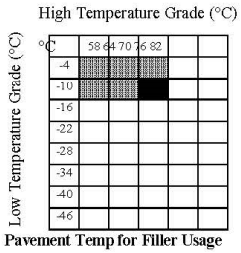
JUNE 2012

READ BEFORE USING THIS PRODUCT

GENERAL Crafco PolyFlex Type 3 is a hot-applied, asphalt based product used to fill cracks and joints in asphalt and portland cement concrete pavements in warm to hot climates. PolyFlex Type 3 is supplied in solid form which when melted and properly applied forms a highly adhesive and flexible compound that resists cracking in the winter and resists flow and pick-up at summer temperatures. Polyflex Type 3 is used in highway, street, airfield and parking lot pavements and is applied to pavement cracks using either pressure feed melter applicators or pour pots. At application temperature, PolyFlex Type 3 is a medium viscosity product which flows and penetrates cracks. PolyFlex Type 3 is formulated as an economical yet effective pavement maintenance crack filler product. Compared to products based on reclaimed rubber, PolyFlex Type 3 offers lower viscosity for easier application, improved summer temperature pick-up resistance, quicker set-up times and improved low temperature flexibility. Polyflex Type 3 has been a quality Crafco product for 20 years. Several states have adopted specifications based on the performance of Polyflex Type 3. VOC = 0 g/l.

USAGE GUIDELINES PolyFlex Type 3 pavement temperature performance limits are 70-10 for crack filling. Usage recommendations are shown in Crafco pavement temperature grade charts shown at the right. Refer to Crafco Product Selection Procedures to determine sealant or filler use and pavement temperature grades.





SPECIFICATION CONFORMANCE The Crafco recommended specification limits for PolyFlex Type 3 when heated in accordance with ASTM D5078 to the maximum heating temperature are as follows:

Test	Recommended Specification
Cone Penetration (ASTM D5329)	20-40
Resilience (ASTM D5329)	30% min.
Softening Point (ASTM D36)	210°F (99°C) min.
Ductility, 77F (25C) (ASTM D113)	30 cm min.
Flexibility (ASTM D3111 Modified)	Pass at 30°F (-1°C)
Flow 140°F (60°C) (ASTM D5329)	3 mm max
Brookfield Viscoisty, 400°F (204°C) (ASTM D2669)	100 Poise max.
Asphalt Compatibility (ASTM D5329)	Pass
Bitumen Content (ASTM D4)	60% min
Tensile Adhesion, 1" (ASTM D5329) 400%	min.
Maximum Heating Temperature 400°F	(204°C)
Minimum Application Temperature	380°F (193°C)

INSTALLATION The unit weight of Crafco PolyFlex Type 3 is 10.0 lbs. per gallon (1.20 kg/L) at 60°F (15.5°C). Prior to use, the user must read and follow Installation Instructions for Hot-Applied RoadSaver, PolyFlex, Parking Lot and Asphalt Rubber Products to verify proper product selection, heating methods, pavement preparation procedures, application geometry, usage precautions and safety procedures. These instructions are provided with each pallet of product.

PACKAGING Packaging consists of individual boxes of product which are palletized into shipping units. Boxes contain a non-adherent film which permits easy removal of the product. Each pallet contains 72 boxes which are stacked in six layers of 12 boxes per layer. The weight of product in each box does not exceed 40 lbs. (18kg) and pallet weights do not exceed 2,880 lbs. (1310kg). Pallets of product are weighed and product is sold by the net weight of product. Product boxes are manufactured from double wall kraft board producing a minimum bursting test certification of 350 psi (241 N/cm^2) and using water resistant adhesives. Boxes use tape closure and do not contain any staples. Boxes are labeled with the product name, part number, lot number, specification conformance, application temperatures and safety instructions. Palletized units are protected from the weather using a three mil thick plastic bag, a weather and moisture resistant cap sheet and a minimum of two layers of six month u.v. protected stretch wrap. Pallets are labeled with the product part number, lot number and net weight. Installation Instructions are provided with each pallet in a weather resistant enclosure.

WARRANTY CRAFCO, Inc. warrants that CRAFCO products meet applicable ASTM, AASHTO, Federal or State specifications at time of shipment. Techniques used for the preparation of the cracks and joints prior to sealing or filling are beyond our control as are the use and application of the products; therefore, Crafco shall not be responsible for improperly applied or misused products. Remedies against Crafco, Inc., as agreed to by Crafco, are limited to replacing nonconforming product or refund (full or partial) of purchase price from Crafco, Inc. All claims for breach of this warranty must be made within three (3) months of the date of use or twelve (12) months from the date of delivery by Crafco, Inc. whichever is earlier. There shall be no other warranties expressed or implied. **For optimum performance, follow Crafco recommendations for product installation**

CRAFCO® INC
AN ERGON COMPANY

RoadSaver 522

Sealing 64-40
Filling 64-46

CRAFCO INC
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PRODUCT DATA SHEET

ROADSAVER 522

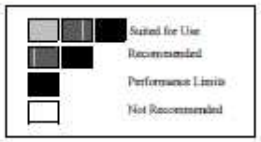
PART NO. 34522

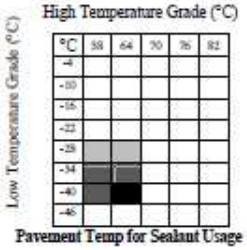
JANUARY 2008

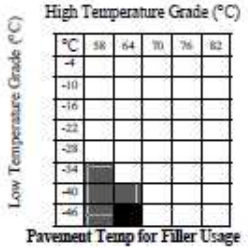
READ BEFORE USING THIS PRODUCT

GENERAL Crafco RoadSaver 522 is a hot-applied asphalt based product used to seal and fill cracks and joints in both asphalt and portland cement concrete pavements in cold to very cold climates. RoadSaver 522 is supplied in solid form which when melted and properly applied forms an adhesive flexible compound with high elongation and low stress development at low temperatures, while resisting flow during the summer. RoadSaver 522 is used in highway, street, and airfield pavements and is applied using either pressure feed melter applicators or pour pots. At application temperature, RoadSaver 522 is a free flowing, self-leveling product. RoadSaver 522 was developed specifically to perform in temperature extremes and movement conditions that exist in the coldest climates. Over the last 20 years, RoadSaver 522 has proven to be one of the best, if not the best performing crack sealant for very cold climates, and has achieved the Crafco **CERTIFIED PERFORMANCE** designation. Several states and Canadian provinces have adopted specifications based on the exceptional performance of RoadSaver 522. Due to the softness of the product RoadSaver 522 is not recommended for use as crack sealant or filler in parking lots or other areas with high foot traffic. VOC = 0 g/l.

USAGE GUIDELINES RoadSaver 522 pavement temperature performance limits are 64-40 for crack sealing and 64-46 for crack filling. Usage recommendations are shown in Crafco pavement temperature grade charts shown at the right. Refer to Crafco Product Selection Procedures to determine sealant or filler use and pavement temperature grades.







SPECIFICATION CONFORMANCE RoadSaver 522 meets requirements of several Agency specifications for low modulus sealant for Minnesota, Montana and Manitoba as follows:

PERFORMANCE VERIFIED PRODUCT
CERTIFIED PRODUCT PERFORMANCE
FIELD AND AGENCY TESTED

Test	Specification Limits
Cone Penetration, 77°F (25°C), dmm (ASTM D5329)	100-150
Cone Penetration, 0°F (-18°C), dmm (ASTM D5329 modified)	25 min.
Flow, 140°F (60°C), 5h (ASTM D5329)	10 mm max.
Resilience, (ASTM D5329)	30-60%
Bond, -20°F (-29°C), 200% ext. (ASTM D5329) 1/2" (12.7mm) thick specimen	Pass 3 cycles
Minimum Application Temperature	380°F (193°C)
Maximum Heating Temperature	400°F (204°C)
Asphalt Compatibility (ASTM D5329)	Pass

INSTALLATION The unit weight of Crafco RoadSaver 522 is 9.6 lbs. gallon (1.15 kg/L) at 60°F (15.5°C). Prior to use, the user must read and follow Installation Instructions for Hot-Applied RoadSaver, PolyFlex, Parking Lot and Asphalt Rubber Products to verify proper product selection, heating methods, pavement preparation procedures, application geometry, usage precautions and safety procedures. These instructions are provided with each pallet of product.

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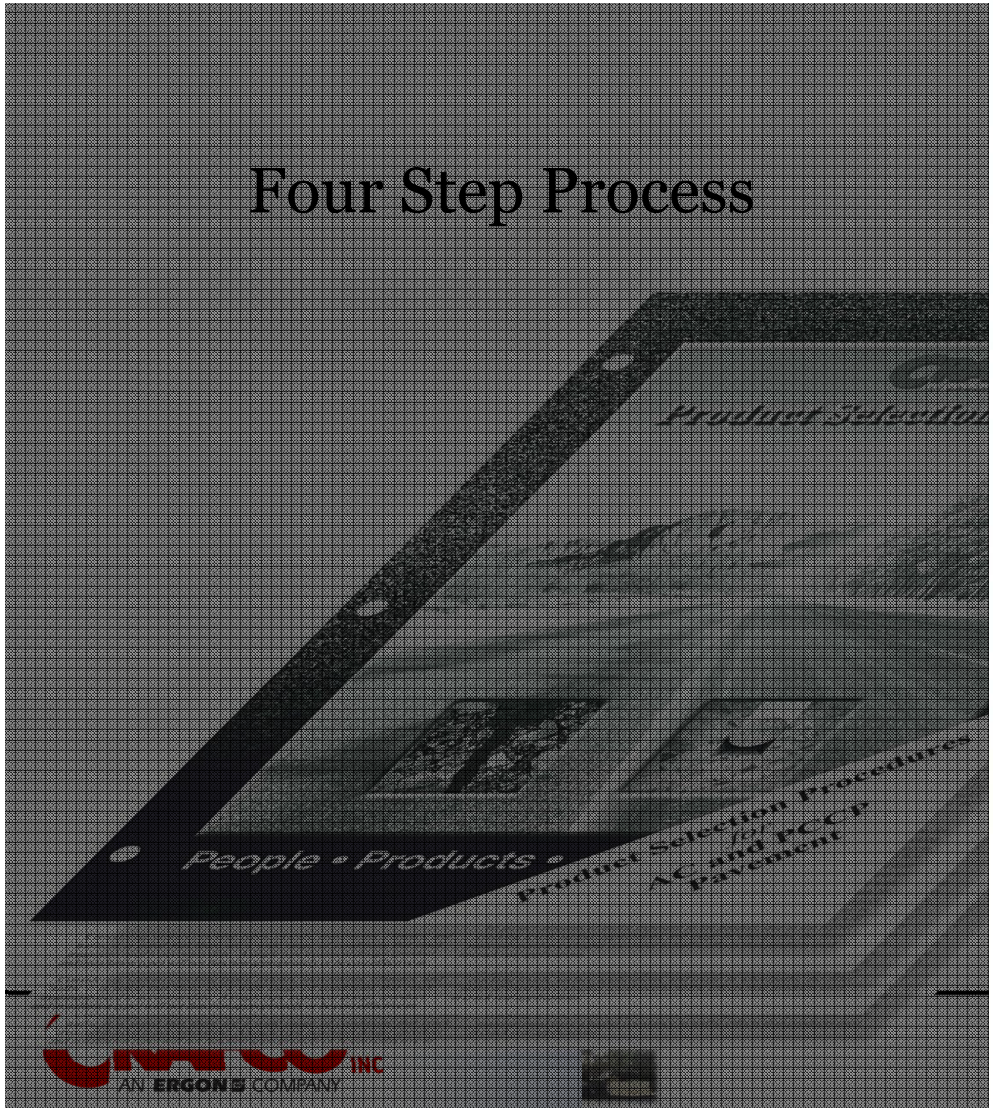
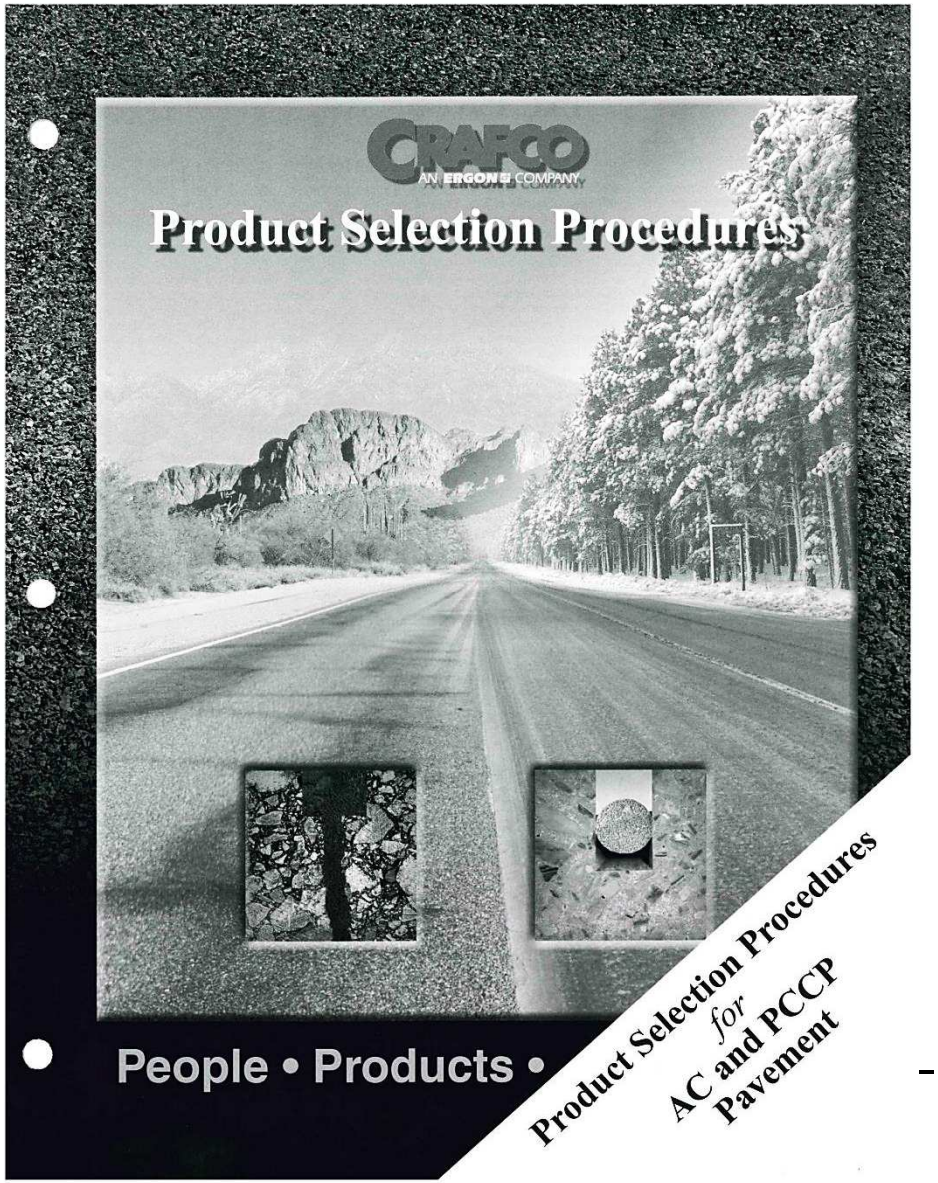
Crafco Product Selection Procedures

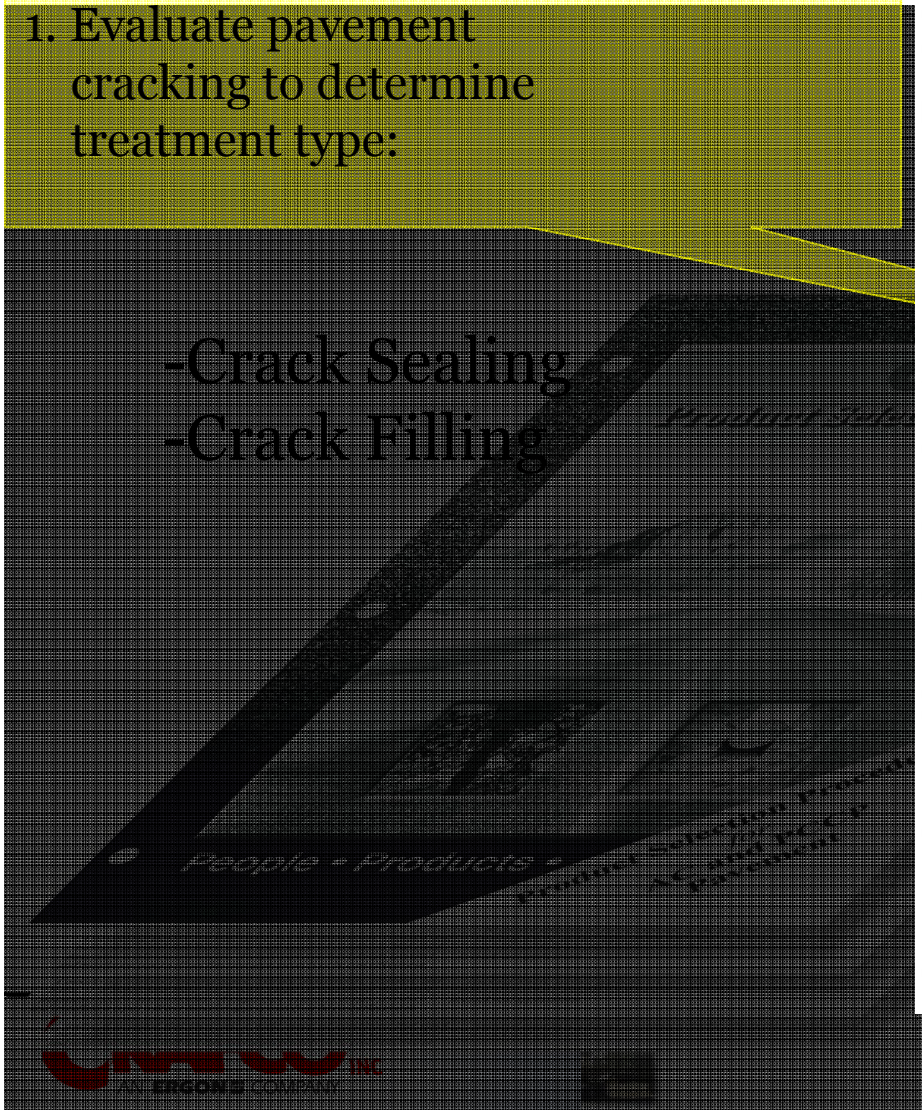




Crafco Product Selection Procedures (AC Pavements)

1. Evaluate pavement cracking to determine treatment type:

-Crack Sealing
-Crack Filling



I. Introduction

Sealing cracks and joints in asphalt and Portland cement concrete pavements is a highly effective preventive maintenance procedure that extends pavement life. Sealing treatments consist of placing an appropriate product into prepared cracks or joints to reduce water entry into base and subbase layers, thus helping to maintain pavement structural capacity.

For sealing to be most effective, long lasting treatment performance is needed. To obtain lasting performance, appropriate products and installation methods are required. Many variables influence performance of crack and joint treatments including pavement type, pavement condition, crack types, cracking extent, climate, and traffic levels. Many different crack and joint treatment products are available which are suited for use in various circumstances. Most of these products will function appropriately in some cases, but may not in others. This guide provides procedures that are used to select the most appropriate crack and joint treatment products and installation methods to result in long lasting performance. Two sets of procedures are included - one for asphalt concrete pavements, and one for Portland cement concrete pavements.

Product Selection Procedures for Asphalt Concrete Pavements

II. Factors That Influence Treatment Selection

Several factors need to be considered when selecting crack treatment processes as follows:

Pavement Condition - Various cracking types and extents can occur in AC pavements. As an AC pavement ages, generally, the first type of cracking that occurs is thermal related transverse cracks. As the pavement continues to age, additional, closer spaced thermal transverse cracks occur, as well as development of other types including fatigue, block, longitudinal, and reflective cracks. Widely spaced thermal transverse cracks (at spacing ranging from 20 to over 100 feet) tend to experience high amounts of opening and closing from summer to winter cycles, with higher amounts of movement for wider spacings. Closely spaced (at less than approximately 20 feet) transverse, longitudinal, block, fatigue, or reflective cracks experience lower amounts of movement from summer to winter. The crack treatment process selected needs to be capable of accommodating movement that it will be subjected to.

Climate Temperature Extremes - The crack treatment product will be subjected to varying temperatures ranging from cold winter lows to summer high pavement surface temperatures. The amount of crack openings and closings from summer to winter is influenced by the high and low temperature range, and crack spacing. Crack treatment product and installation methods should be selected to accommodate these movements.

Traffic Effects - Traffic volumes vary widely on pavements. Areas with high traffic may require use of stiffer, more traffic resistant crack treatment products, especially in more highly cracked pavements. Slower traffic speeds, and high amounts of pedestrian usage, such as in city streets or parking lots can also require more traffic resistant treatments.

III. Crack Treatment Process Selection

Considering various cracking types, extents, movements, climates, and traffic it is noted that there are a wide range of conditions that crack treatments need to accommodate. A single type treatment design (product and installation type) will not function appropriately or be cost effective in all applications. Crack treatments need to be able to function in the specific climate (high temperature vs low temperature properties of the product), need to be able to withstand movements of the crack type being treated (installation geometry), need to withstand traffic, and need to be able to remain adhered to pavement surfaces which are in varying state of deterioration. In general as pavements age and increase in distress, cracking frequency increases, and forms at closer and closer spacings which results in lesser amounts of crack movements. Therefore, in pavements with higher amounts of cracking, the product will be exposed to lower movement amounts, than in pavements (in the same climate) with less frequent cracking. Also pavements with greater amounts of cracking, when treated will have greater amounts of product on the pavements, which will be subject to greater traffic exposure. Two types of crack treatments are used to accommodate these varying conditions - Crack Sealing, and Crack Filling.

Selection of an appropriate crack treatment process consists of identifying the product type and installation methods to be used, considering the specific pavement condition, climate, and traffic factors for the project.

The process consists of four steps:

1. Evaluate pavement cracking and condition to determine treatment type
2. Determine temperature extremes
3. Adjust for traffic conditions
4. Select an appropriate Crafco Crack Treatment Product

Step 1. Evaluate Pavement Cracking And Condition To Determine Treatment Type

Crack Sealing: Crack sealing processes are primarily appropriate for pavements which are in good condition and primarily exhibit thermal transverse and/or reflective cracks which experience high amounts of movement. To provide a functioning seal in this application, routed reservoirs of sufficient width to enable the sealant to accommodate movement are required. Sealant products need to have sufficient low temperature extensibly, adhesive, and cycling characteristics to withstand the crack openings during winter cycles. The sealant product is placed in controlled applications to fill the crack. Transverse crack spacing should not average less than 20 feet. The pavement at the cracks needs to be sound and intact enough to resist raveling and deterioration from the reservoir cutting operation. Pavements suited for rout and seal should not have significant amounts of random, fatigue, or longitudinal cracks, especially in wheel paths. In rout and seal applications, due to the controlled product applications, traffic effects on sealant are minimal.

Crack Filling: Crack filling processes are primarily appropriate for pavements which are exhibiting greater amounts and types of cracking than those in which crack sealing is used. The crack filling process consists of cleaning the cracks (routing may or may not be used), and then filling with a appropriate product that has sufficient stiffness to be resistant to the effects of traffic, while being flexible enough at low temperatures to resist cracking. Pavements for which filling is appropriate are those with higher levels of cracking, such as transverse cracks spaced at less than 20 feet, significant amounts of longitudinal cracking, especially in wheel paths, closely spaced block cracking or fatigue cracking. Sealant may be placed in routed cracks, or in overband only applications. Since there will be greater amounts of traffic exposure to the product, due to the higher cracking levels, surface applications, and usage in wheelpaths, the filler material must have a higher resistance to traffic effects than products used in crack seal applications.

2. Determine temperature extremes.

3. Adjust for traffic conditions.

4. Select appropriate Crafco product.

Step 2. Determine Temperature Extremes

The FHWA LTPPBIND process determines high and low pavement temperatures throughout the United States and Canada. Temperatures determined by this process are used to select the appropriate grade of asphalt cement for use in asphalt concrete paving mixtures. This process determines the appropriate asphalt cement grade to be used in paving considering temperature, depth in the pavement, traffic and statistical reliability for the temperature variations. High and low temperature requirements are determined in 6°C increments with high temperatures ranging from 52° to 76°C, and low temperatures ranging from -10° to -40°C. Typical asphalt grades include 58°-40°C for very cold temperatures, 64° -22°C for moderate climates, and 70° -10°C for very hot climates. Crack sealant or filler materials used need to function at both the high temperature and low temperatures they will be exposed to.

For sealant and filler product selection, the LTPPBIND surface temperature grade for 98% reliability at the project is determined. Crafco products are classified for usage in various climates for sealing and filler usage in accordance with this system.

Step 3. Adjust For Traffic Conditions

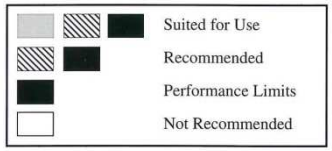
For crack sealing applications, product is placed in routed reservoirs, in controlled, limited applications, therefore, traffic effects are minimal. However, for crack filling applications, greater amounts of product are placed on the pavement, and traffic effects may be greater. The product climate ratings for filler consider typical filler usage, however, an increase in high temperature grade is needed for filler use in extreme traffic conditions such as parking lots, city streets with high levels of standing traffic; high volume slow moving traffic, high levels of wheel path cracking; severe braking areas, high levels of pedestrian traffic, etc. The adjustment simply consists of increasing the high temperature grade by 1 increment (6°C) to require a product with increased high temperature stiffness. If desired, for even greater high temperature stiffness the high temperature grade can even be increased by 2 increments (12°C).

Step 4. Select An Appropriate Crafco Crack Treatment Product

Crafco Products are classified for use in sealant, filler, or both applications as listed in the Usage Guideline Section of Product Data Sheets. In addition, products are rated for use in high and low temperature grades according to the LTPPBIND 98% reliability temperature grade determinations for various climates. Temperature grade recommendations are presented in chart form for both sealant and filler usage. The charts list the climate ranges that products can be used in, and should not be used in. The climate and usage recommendations are based on physical property evaluations of products at the temperature extremes and field performance data. (See Chart below)

RoadSaver 522 can be used in both crack sealing and crack filling installations. For crack sealing installations, the levels of performance are in climates that range down to -40°C in the winter, and up to 64°C in the summer. For crack filler usage, the performance limits are down to -46°C in the winter and 64°C in the summer. These specific 64° -40°C and 64° -46°C climates are shown in the charts as a block box listed as the performance limits of the product. RoadSaver 522 can also be used in climates that do not get as cold as -40°C or -46°C in the winter, or as warm as 64°C in the summer. For sealant usage, RoadSaver 522 can also be used in 58°-40°C, 58° -28°C, 58° -34°C, 64° -28°C , and 64° -34°C climates. For filler usage, it can also be used in 58° -34°C, 58° -40°C, 58° -46°C, and 64° -40°C climates. Use is not recommended in all other climates shown in the charts due to the temperature and cost effectiveness considerations.

USAGE GUIDELINES RoadSaver 522 pavement temperature performance limits are 64-40 for crack sealing and 64-46 for crack filling. Usage recommendations are shown in Crafco pavement temperature grade charts shown at the right. Refer to Crafco Product Selection Procedures to determine sealant or filler use and pavement temperature grades.



High Temperature Grade (°C)

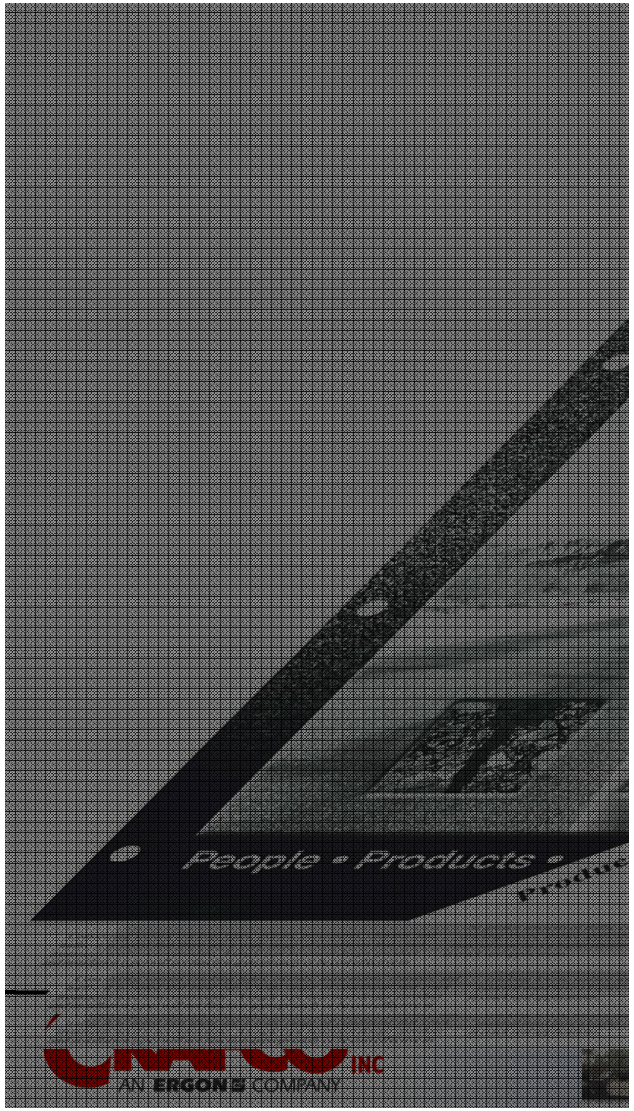
Low Temperature Grade (°C)	58	64	70	76	82
-4					
-10					
-16					
-22					
-28					
-34					
-40					
-46					

Pavement Temp for Sealant Usage

High Temperature Grade (°C)

Low Temperature Grade (°C)	58	64	70	76	82
-4					
-10					
-16					
-22					
-28					
-34					
-40					
-46					

Pavement Temp for Filler Usage



Crafco Product Selection Procedures (PCCP Pavements)

I. Factors That Influence Treatment Selection

For PCC pavement, several factors need to be considered when selecting joint sealing treatments as follows:

Joint Sealing or Resealing - Resealing joints in old PCC pavement may use different products and installation methods than for initial sealing of joints in new pavements. In new pavements, joints are typically narrower, have uniform cut cross sections and are not contaminated with old sealant. In older joints being resealed, joints are typically wider, will be contaminated, and may not be uniform due to spalling degradation. Spacing of older joints may be greater than in new pavements, which could result in increased thermal movements from summer to winter.

Climate Temperature Extremes - The joint seal product will be subjected to varying temperatures ranging from cold winter lows to summer high pavement surface temperatures. The amounts of joint openings and closings from summer to winter is influenced by the high to low temperature range and joint spacing. Joint seal products should be selected which will accommodate these movements and these temperatures.

Joint Spacing - Joint spacings for PCC pavements range from approximately 10 to 100 feet (3 to 30 meters). Longer joint spacings result in greater joint movements.

Desired Longevity - Various sealant product types have different lifespans and costs. Treatment cost versus lifespan should be considered.

Other Factors - In some uses, such as in airfields and parking or refueling areas, sealant with fuel resistance properties may be required. Additionally, in airfield take-off areas, jet-blast resistance may be needed.

II. Joint Sealing Process Selection

Considering the various conditions that joint sealing treatments need to accommodate, an appropriate product type needs to be selected to function at the specific project.

Selection of an appropriate joint seal treatment consists of identifying the product type and installation methods to be used, considering the specific pavement joint conditions, climate, spacings, and desired longevity for the project. The process consists of the following steps:

1. Determine pavement and joint conditions
2. Determine if fuel or blast resistance is required
3. Determine temperature extremes
4. Select an appropriate Crafco joint sealant product

Step 1. Determine Pavement And Joint Conditions

Determine if the project is sealing of joints in new PCC pavement or resealing joints in older PCC pavement. Installation instructions for each process vary somewhat and need to be followed as listed on Crafco Application Instructions for the specific product used. Joint spacing, width, and planned depth to width ratio should also be identified due to the influence on sealant extensions. Desired longevity of the sealing treatment should also be considered. For joints in new concrete pavements, the longest lasting joint seal types such as RoadSaver Silicone or Low Modulus Hot-applied RoadSaver or Superseal products should be used. For resealing, however, less costly product types including appropriate hot-applied asphalt based materials may be considered.

Step 2. Determine Fuel Or Blast Resistance Needs

If the joints are in areas that are routinely subjected to fuel spillage, such as aircraft or vehicle refueling areas, the product used should be a fuel-resistant type product to resist degradation from exposure to fuel. For areas with regular exposure to fuel, Crafco Superseal products should be used. For areas subjected to intermittent or infrequent fuel spillage, Superseal or RoadSaver Silicone products may be used. If joints will be in airfield take off areas that are subject to significant jet blasts directed at the pavement, blast resistant products including Superseal 200E or RoadSaver Silicone should be used.

Step 3. Determine Temperature Extremes

The FHWA LTPPBIND process determines high and low pavement temperatures throughout the United States and Canada. Temperatures determined by this process are used to select the appropriate grade of asphalt cement for use in asphalt concrete paving mixtures. This process determines the appropriate asphalt cement grade to be used in paving considering temperature, depth in the pavement, traffic and statistical reliability for the temperature variations. High and low temperature requirements are determined in 6°C increments with high temperatures ranging from 52° to 76°C, and low temperatures ranging from -10° to -40°C. Typical asphalt grades include 58°-40°C for very cold temperatures, 64° -22°C for moderate climates, and 70 -10°C for very hot climates. Even though this process is based on asphalt concrete pavements, the temperature ranges determined are of use with PCC pavements. Low winter temperatures will be very similar and hot summer surface temperatures for PCC will be somewhat lower than those for asphalt concrete due to coloration differences. Therefore, high temperature determinations from LTPPBIND can be used for PCC pavement surfaces, and the results will be somewhat conservative. Joint sealant materials used need to function at both the high temperature and low temperature that will be experienced.

For joint sealant product selection, the LTPPBIND surface temperature grade for 98% reliability at the project is determined. Crafco sealant products are classified for usage in various climates in accordance with this system.

Step 4. Select An Appropriate Crafco Joint Sealant Product

Crafco products that are suitable for joint sealant use are identified on Product Data Sheets. Fuel resistance and blast resistance characteristics are also identified. In addition, products are rated for use in high and low temperature grades according to the LTPPBIND 98% reliability temperature grade determinates for various climates.

Temperature grade recommendations are presented in chart form for sealant usage. The charts list the climate ranges that product can be used in and should not be used in. The climate and usage recommendations are based on physical property determinations of products at the temperature

www.crafco.com
For more information on Crafco products contact your local Crafco Distributor or call:
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Phone 602-276-0406 • Fax: 480-961-0513

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 2-02

i.e. – Benefits

- Less money spent to maintain pavement[1,4]
- Less time wasted in traffic because a road is closed due to more extensive maintenance[6]
- Decreased exposure of highway workers to traffic[6]
- Smoother ride[7]
- Less money you spend repairing your vehicle[8]

Urban road decay costs average drivers up to $377 each year[8]

THANK YOU