Validation of Hot-Poured Asphalt Crack Sealant Performance-Based Guidelines

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Asphalt Crack Sealant Field Installation Guidelines

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Illinois Center for Transportation
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1 **Scope**

This guideline document is prepared to guide pavement maintenance personnel in the selection, installation, and evaluation of materials for hot-poured crack sealant treatments for flexible pavements. The information provided in this guideline is based on the field performance of 17 conventional sealants installed at five different sites in North America as part of the FHWA TPF-5 (225) pooled fund study: “Validation of Hot-Poured Crack Sealant Performance Based Guidelines”.

The document covers the following phases:

- Planning and design considerations;
- Treatment and sealant selection;
- Installation equipment and procedures.

Key components of each phase and best practices are summarized for the following two treatments applied for flexible and composite pavements:

Crack filling (also known as clean and seal) treatment: Direct application of hot-poured asphalt crack sealant to cracks after cleaning.

Crack sealing (rout and seal) treatment: Application of hot-poured asphalt crack sealants to the reservoirs prepared by routing the existing cracks.

2 **Planning and Design**

2.1 **Primary Considerations**

*Climatic Condition*

Prior to sealant installation, information from the closest weather data station should be obtained. The ambient temperature should be greater than 40°F and lower than 80°F for proper crack sealing installation. Spring and fall are the best time of the year for crack sealing, when the cracks are not at their extreme closures or openings.

*Pavement Initial Condition*

Pavement and cracks initial condition should be evaluated to determine the best treatment for cracked pavement. Pavement type, rehabilitation history, traffic, climate, overlay condition of existing pavement, and scheduled treatments (if any) should be reported. The pavement evaluation report should include pavement distresses; pavement condition index, condition rating score, or International Roughness Index (IRI); and crack type, density, and severity. A sample survey form to report ambient temperature, traffic, and pavement and cracks initial condition is included as attachment A.

The selection of strategies based on crack density and average level of crack deterioration (percentage of crack length) as presented by the SHRP study (Smith and Romine 1999) is still valid. Figure 1 presents various maintenance strategies adopted by the SHRP study based on average level of edge deterioration, which consists of spalls and secondary cracking. According to this study, crack sealing is recommended for the cracks that have less than 50% edge deterioration.
Low Crack Density: Linear crack length per 330ft pavement section to be less than 33ft
Moderate Crack Density: Linear crack length per 330ft pavement section to be from 33 to 440ft
High Crack Density: Linear crack length per 330ft pavement section to be more than 440ft

Figure 1. Guidelines to select the type of maintenance (Smith and Romine, 1999)

Crack sealant treatment is suitable for pavements with transverse and longitudinal cracking. Crack sealant treatment must be applied to cracks with little or no branching. Cracks shall not be a part of web cracks. Crack sealant treatments are not recommended for cracks wider than 25 mm. Figure 2 illustrates some examples of acceptable and unacceptable crack patterns. In addition, pavements exhibiting severe fatigue and block cracking are not recommended for crack sealant treatment.
Figure 2. Various crack patterns to be considered in the selection of surface or crack treatments: (a) Cracks with severe branching and spalling (not recommended for crack sealing or filling, (b) Cracks with no branching and no spalling are appropriate for crack sealing or filling

Safety
The safety hazards of sealants and equipment used during preparation and sealant installation should be presented to the workers. The crew should be well trained on field safety at work-zone, the equipment use and material handling in accordance with the material safety data sheets (MSDS).

Traffic Control
Traffic control measures should be taken to ensure the safety of the workers and passing traffic. Traffic closure and opening time should be adjusted per sealant requirements to gain sufficient strength prior to traffic passage. It is recommended to not open the section to traffic for at least 15 minutes after crack sealing has been installed to prevent early sealant tracking or debris intrusion into sealant.

2.2 Treatment Selection
Once a decision is made to perform crack sealant treatment, two types of crack sealant treatment are available for selection based on the initial condition of pavement and crack type. These treatment types are described below and also summarized in Table 1.

Crack Sealing: This method is defined as the application of hot-poured crack sealant in pre-routed and cleaned reservoir. The routing operation creates a rectangular reservoir (for example 3/4" x 3/4"). This method is recommended for cracks exhibiting significant vertical and horizontal movements, often referred to as working cracks. The reservoir above the crack helps
to accommodate crack movement. Working cracks are defined as cracks with annual horizontal movement of more than 0.1 in. Types of cracks that might be considered to be working cracks are transverse thermal cracks, transverse reflective cracks, longitudinal reflective cracks, and longitudinal cold-joint cracks.

**Crack Filling:** This method is defined as the direct injection of hot-poured crack sealant in a cleaned crack. This method is recommended for non-working cracks. Non-working cracks are defined as cracks with annual horizontal movement of 0.1 in or less. Types of cracks that might be considered to be non-working cracks are longitudinal reflective cracks, longitudinal cold-joint cracks, longitudinal edge cracks, and thermal or reflective transverse cracks with minimal movement.

### 2.3 Material Selection

Various types of hot-applied thermoplastic materials are available for crack sealing and filling. Currently, most of the agencies’ preferred method of material selection is based on ASTM standards. According to these standards such as ASTM D6690, crack sealants can be categorized in four groups; type I, type II, type III, and type IV. ASTM classifications are related to penetration resistance, softening point, bonding strength, and asphalt compatibility. Agencies often make a decision on material choice based on the modulus characteristics of sealants. Low modulus sealants (likely to be ASTM Type II to IV) are often preferred in wet-freeze zones whereas high modulus products (likely to be ASTM Type I to II) are preferred for dry no-freeze climatic regions. Generally, crack filling requires selection of a product with slightly higher modulus for the same climatic region. Polymer modified asphalt emulsion, asphalt binder, fiberized asphalt, and rubberized asphalt are also among the products used in crack sealing and filling applications.

**Table 1. Recommended criteria for treatment selection (Smith and Romine, 1999)**

<table>
<thead>
<tr>
<th>Crack Characteristics</th>
<th>Crack Treatment Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crack Sealing</td>
</tr>
<tr>
<td><strong>Width</strong>, in 0.2 to 0.7</td>
<td>Minimal to None (≤25 percent of crack length)</td>
</tr>
<tr>
<td><strong>Edge Deterioration</strong> (i.e., spalls, secondary cracks)</td>
<td>≥ 0.1</td>
</tr>
<tr>
<td><strong>Annual Horizontal Movement</strong>, in 0.2 to 0.7</td>
<td>Transverse Thermal Reflective Cold-Joint</td>
</tr>
<tr>
<td><strong>Type of Crack</strong></td>
<td>Transverse Thermal Reflective Cold-Joint</td>
</tr>
<tr>
<td></td>
<td>Longitudinal Reflective Cold-Joint</td>
</tr>
</tbody>
</table>

1 For cracks wider than 1 in other treatment types are recommended such as using mastics.

Recently, performance-based guidelines were developed as a systematic procedure to select hot-poured bituminous crack sealants. These guidelines use a “Sealant Grade” (SG) system to select hot-poured crack sealant based on environmental conditions (Al-Qadi et al, 2009). The sealant standards are as follows:

AASHTO MP-25, Performance-Graded Hot-Poured Asphalt Crack Sealant (under review)
AASHTO PP xx, Grading or Verifying the Sealant Grade (SG) of a Hot-Poured Asphalt Crack Sealants (under review)

AASHTO TP 85, Apparent Viscosity of Hot-Poured Asphalt Crack Sealant Using Rotational Viscometer

AASHTO TP 86, Accelerated Aging of Hot-Poured Asphalt Crack Sealants Using a Vacuum Oven

AASHTO TP 87, Measure Low-Temperature Flexural Creep Stiffness of Hot-Poured Asphalt Crack Sealants by BBR

AASHTO TP 88, Evaluation of the Low-Temperature Tensile Property of Hot-Poured Asphalt Crack Sealants by Direct Tension Test

AASHTO TP 89, Measuring Adhesion of Hot-Poured Asphalt Crack Sealant Using Direct Adhesion Tester

AASHTO TP 90, Measuring Interfacial Fracture Energy of Hot-Poured Crack Sealant Using a Blister Test

AASHTO TP xx, Evaluation of the Tracking Resistance of Hot-Poured Asphalt Crack Sealants by Dynamic Shear Rheometer (DSR) (currently under review)

These aforementioned laboratory tests allow for measuring hot-poured bituminous-based crack sealant’s rheological and mechanical properties over a wide range of service temperatures. Thresholds for each test were identified to ensure desirable field performance. For example, Sealant Grade (SG) 52-34 suggests that sealant can be used at a high service temperature of 52°C and a low service temperature of -34°C. Hence, using the developed laboratory tests, a proper crack sealant can be selected systematically based on expected service temperature. Figure 3 shows different zones for the pavement’s low temperature in North America that can be used to select the proper sealant based on its SG.

![Figure 3. North America low pavement temperature zones (according to LTPP Bind V3.1)](image-url)
3 Procedures and Equipment

The following steps are suggested for crack sealant installation (details of each step follows):

Step 1 – Crack routing: Cracks are cut to specific reservoir geometry using a router. This step is only used in crack sealing treatment.

Step 2 – Crack cleaning and drying: Cracks or prepared reservoirs are cleaned of debris and dried by applying hot air. This step is used for both crack sealing and crack filling treatment. A hot air lance equipped with compressed air is commonly used for cleaning and drying.

Step 3 – Material handling and preparation: Sealant materials are placed in the kettle for melting prior to installation. The materials are heated up to the manufacturer’s recommended installation temperatures.

Step 4 – Crack sealant installation: Melted and homogenized sealant material in the kettle is injected to fill crack or reservoir.

Step 5 – Blotting (optional): After sealant application, sealant surface can be temporarily protected from direct application of traffic using chemicals or simply paper towels.

3.1 The list of equipment required for crack sealing is presented in Crack Routing

Crack routing is the cutting out process of a portion of pavement on either side and top of the crack to establish a uniform rectangular reservoir (for example 3/4” x 3/4”). This reservoir is required to provide the sealant material sufficient pavement surface to adhere. The cracks can be cut as square or rectangular geometry using a saw or router (Figure 4). Routs must be square or rectangular. Rounded and V-shaped routs, which often result from worn or misaligned blades, must be avoided. It is recommended to make trial cuts before cutting the cracks specified for the job. Rout geometry should be checked to make sure routs have correct width and depth (Figure 5). Using an aluminum block with same dimensions as rout width and depth is highly recommended for inspection of routing operation. By inserting such a block into a rout, further recommendation can be made. For example, blade spacing should be adjusted as needed to ensure the correct routing size (Figure 6) is achieved. Routing and sealing should be extended to full shoulders.
Table 1. Details of crack sealant installation steps are discussed next.

### 3.2 Crack Routing

Crack routing is the cutting out process of a portion of pavement on either side and top of the crack to establish a uniform rectangular reservoir (for example 3/4” x 3/4”). This reservoir is required to provide the sealant material sufficient pavement surface to adhere. The cracks can be cut as square or rectangular geometry using a saw or router (Figure 4). Routs must be square or rectangular. Rounded and V-shaped routs, which often result from worn or misaligned blades, must be avoided. It is recommended to make trial cuts before cutting the cracks specified for the job. Rout geometry should be checked to make sure routs have correct width and depth (Figure 5). Using an aluminum block with same dimensions as rout width and depth is highly recommended for inspection of routing operation. By inserting such a block into a rout, further recommendation can be made. For example, blade spacing should be adjusted as needed to ensure the correct routing size (Figure 6) is achieved. Routing and sealing should be extended to full shoulders.
Table 2. List of equipment needed for crack sealing and filling

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Primary Use</th>
<th>Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router</td>
<td>Making reservoirs at different sizes for sealant application.</td>
<td><img src="image1.jpg" alt="Router Picture" /></td>
</tr>
<tr>
<td>Hot air lance</td>
<td>Drying crack or reservoir walls.</td>
<td><img src="image2.jpg" alt="Hot Air Lance Picture" /></td>
</tr>
<tr>
<td>Leaf Blower</td>
<td>Cleaning dust and debris out of the routs and pavement surface.</td>
<td><img src="image3.jpg" alt="Leaf Blower Picture" /></td>
</tr>
<tr>
<td>Kettle</td>
<td>Heating and melting sealant to installation temperature.</td>
<td><img src="image4.jpg" alt="Kettle Picture" /></td>
</tr>
<tr>
<td>Applicator</td>
<td>Pouring sealant into cracks or routs.</td>
<td><img src="image5.jpg" alt="Applicator Picture" /></td>
</tr>
<tr>
<td>Squeegee</td>
<td>Leveling and finishing sealant providing a band extension on either side of crack.</td>
<td><img src="image6.jpg" alt="Squeegee Picture" /></td>
</tr>
</tbody>
</table>
Properly prepared reservoirs are critical for sealant performance. Most of the problems associated with reservoir preparation can be attributed to poor workmanship. In some occasions,
however, different methods of treatment may help avoid rout related problems. There are a number of issues that can affect the quality of routing. Cracking pattern, partially developed cracks and surface texture of asphalt mixtures can pose significant challenges to achieve desired shape and quality of reservoirs. Three scenarios that a router may face during routing and must pay special attention to are described below:

**Wavy Cracks:** Extra attention should be paid to wavy cracks by routers to improve accuracy. Wavy cracks pose challenges since they can be missed by the router operator, who may cut the pavement instead. This may lead to spalling of the pieces left between rout and crack as shown in Figure 7.

![Figure 7. Wavy cracks that can be missed by routers](image)

**Zigzag Cracks:** Routing these cracks requires more than improving workmanship; the router may increase rout width to capture crack pattern with a greater accuracy or use crack filling technique instead of crack sealing. Cracks with sharp edges and torturous patterns (frequent zigzags) can create significant challenges to the routing operation. Surface texture and asphalt mixture type are the primary cause of the cracking patterns; significant amounts of spalling can occur as a result of routs not following the crack patterns as shown in Figure 8. The amount of spalling in such cracks can be 10-20% of total crack length.
Figure 8. Cracks with torturous pattern leading to spalling

Partially Developed Crack: Partial cracks are defined as the cracks that are not fully developed on the pavement surface, covering only a certain percentage of lane width. In some occasions, routs are cut for the full lane width even though crack only partially appears at the surface. It is very likely that cracking may develop elsewhere on the surface not matching the initially prepared rout (Figure 9).

Figure 9. Partially developed cracks
3.3 Crack Cleaning and Drying

The routing operation shall be immediately followed by cleaning and sealant installation. It is critically important to clean and dry the cracks to improve adhesion between sealants and crack’ or rout’s wall. It is recommended to perform a multi-stage cleaning to obtain a clean reservoir free from dust and debris. It is recommended to postpone sealant installation when pavement is wet. The cleaning operations shall be completed in four steps:

1. Pavement surface and inside of the rout must be cleaned. Pavement surface must be free of dust, dirt, debris, any foreign material, and loose edges from the sawing/routing operations (Figure 10). A mechanical sweeper, a large vacuum system, or simply a leaf blower can be used to perform first stage cleaning of the pavement surface. This will prevent dust and debris from blowing back into the rout due to the movement of construction vehicles and workers.

2. Cleaning shall take place right before sealant placement. A compressor or vacuum cleaning system shall be used to clean inside the rout and immediate surroundings. The compressor shall be equipped with oil and moisture filters and providing at least a 100 psi (690 kPa) pressure at the nozzle and a minimum blast flow of 150 ft³/min. Oil and moisture filters shall facilitate the operation by providing dry, oil-free air. Filters must be inspected for cleanliness/damage prior to the operation and shall be replaced if damaged or not clean.

3. Rout cleanliness should be checked visually after cleaning. Duct tape shall be used to check cleanliness of the routs. Press the sticky surface of about 3 ft of duct tape on to rout walls. When removed, there should be none to very little residue on the tape. Further cleaning shall be applied if the result is unsatisfactory.

4. A hot air lance (HAL) equipped with compressed air shall be used immediately (not to exceed 2 min) before the placement of sealant. This will serve to ensure crack wall dryness and heating. HAL temperature must be kept below 500°C to minimize pavement damage. Care should be taken not to burn, scorch, or ignite the adjoining pavement (Figure 11).

![Figure 10. First stage: Cleaning of pavement surface and rout using a leaf blower](image-url)
Figure 11. Second stage: Cleaning and drying using a hot air lance equipped with compressed air

3.4 Material Handling and Preparation

Heating of sealant materials in preparation for installation is one of the critical steps to ensure good quality sealant treatments. Sealants are usually heated in hot-oil double boiler and agitated kettles with automated temperature controls. Recommended temperature for melting sealant block varies from 340-400°F depending on the type and composition of the product. The duration and temperature inside the kettles are critical for sealant integrity. Therefore, it is critical to follow manufacturer’s recommended heating temperatures and not to overheat the material, which may cause degradation of the sealant. It may take up to 2 hours to reach recommended heating temperatures after placing the sealant blocks in the kettle. Underheating material can also effect the adhesion of sealants and results in improper bonding between rut and sealant.

Figure 12 illustrates temperature history of a sealant material in a fully automated kettle. The measurements were taken using thermocouples inside the kettle at various locations and from the kettle’s control panel. The heating duration may vary based on the amount of material placed in the kettle and type of the heating system. Therefore, it is recommended to prepare a calibration record for each kettle system to estimate a reasonable time to reach to installation temperature before sealant application.
(a) Monitored temperature history for a material
(b) Expected temperature history for a calibrated sealant kettle

Figure 12. Typical temperature history of a sealant material

The kettle calibration procedures are outlined below:

1. Fill the kettle with blocks of sealant to three-quarters full position with a typical sealant material used in the installation
2. Start recording temperatures every 10 minutes using the kettle’s control panel
3. Using a long probe with calibrated thermocouples at the tip (Figure 13), record temperature every 10 minutes starting 30 minutes after the placement of sealant blocks in the kettle.

Figure 13. External temperature recording using a long probe with thermocouples at the tip

4. After the control panel shows the recommended heating temperature, take a sample from the kettle and place it in a small metal quart can. Immediately measure the temperature inside the can using a small-probe calibrated thermocouple. Continue taking samples at
intervals of 10 minutes until the temperature in the can and inside the kettle reaches the recommended temperatures.

5. Record the time (±10 minutes) when recommended heating temperature is reached after placing the sealant in the kettle. This will be the reasonable starting time for installation.

6. Compare the readings from external probes and kettle’s control panel reading after the equilibrium is reached. Calculate a correction factor to adjust kettle’s control panel reading to external readings taken by calibrated thermocouples.

The calibration protocol should be repeated every year or prior to the season of installation. A sample form presented in Attachment A can be used for temperature recording.

The kettle should be at least three-quarter full. Sealant installation should start at the reasonable starting time. After sealant installation starts, the temperature should be adjusted frequently by using kettle control panel to avoid overheating. It is possible that new sealant blocks be added to the kettle during the installation to maintain same amounts of material in the kettle. This will regulate the temperature control feedback mechanism and reduce overheating.

At the end of the day, the material inside the kettle should be drained to start the next day with unheated materials. Reheating the sealant left in the kettle may reduce its quality.

3.5 Crack Sealant Installation

3.5.1 Derivatives of Sealant Configuration

Following the aforementioned procedures in preparation of cracks for sealant treatment, sealant is installed in the routs or directly in the cracks. The configuration for sealant installation will not only dictate the amount of materials used in a sealing job but also the lifetime of sealant treatment. The commonly applied configurations for sealant crack filling are shown in Figure 14, and for crack sealing are shown in Figure 15 and listed below:

- Flush fill
- Reservoir
- Overband
- Combination (reservoir and overband)

![Figure 14. Crack filling common configurations](image)
Several factors need to be considered for selection of sealant placement configuration. The SHRP study (Smith and Romine, 1999) and field evaluations of the pooled fund study 5 (225) - Validation of Hot-Poured Crack Sealant Performance-Based Guidelines), Sealant Installation Procedures

Melted and homogenized sealants are poured in the crack or the precut reservoir using an applicator attached to the end of the nozzle. Different types of applicators are used for sealant installation to control the amount of sealant injected into a rout or crack. Some of the common applicators are horse shoe, disk, and flush fill (Figure 16).

Table is recommended to be used to select the placement configuration for sealant materials.

3.5.3 Sealant Installation Procedures

Melted and homogenized sealants are poured in the crack or the precut reservoir using an applicator attached to the end of the nozzle. Different types of applicators are used for sealant installation to control the amount of sealant injected into a rout or crack. Some of the common applicators are horse shoe, disk, and flush fill (Figure 16).

Table 3. Considerations for Sealant Placement Configuration.

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Clean and Seal</th>
<th>Rout and Seal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type and Extent of Operation</td>
<td>No crack cutting operation; hence, duration of operation can be shorter. Can be preferable when traffic closures are a concern.</td>
<td>Duration of operation is greater due to routing and cleaning. Requires more traffic closure time.</td>
</tr>
<tr>
<td>Traffic</td>
<td>Overband wear is similar to crack seal configurations; however, the impact on sealant in the crack is less severe.</td>
<td>Overband configurations experience wear and, subsequently, high tensile stresses directly above the crack edge, leading to internal rupture.</td>
</tr>
<tr>
<td>Crack Characteristics</td>
<td>Overband configurations are more appropriate for cracks having a considerable amount of edge deterioration (&gt;10% of crack length), because the overband simultaneously fills and covers the deterioration segments in the same pass.</td>
<td></td>
</tr>
<tr>
<td>Material Type</td>
<td>Material such as emulsion, asphalt cement, and silicone must be placed unexposed to traffic due to serious tracking or abrasion problems.</td>
<td></td>
</tr>
<tr>
<td>Desired Performance</td>
<td>For long-term sealant performance, flush, reservoir, and overband configurations should be considered (combination configuration).</td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>Filling configurations require less material than reservoir configurations, resulting in lower costs.</td>
<td>Combination configurations require significantly more material than reservoir configurations, resulting in higher costs.</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>

(a) Horse shoe  
(b) Disk  
(c) Flush fill

**Figure 16. Various sealing applicators**

Depending on the reservoir configuration selected for the project, a V-shape squeegee can be used to apply a uniform overband right after pouring the material (Figure 17).

**Figure 17. Using a squeegee for overband application**

It is recommended to use the overband configuration for crack filling and sealing treatments. A typical overband configuration for a crack filling treatment is shown in Figure 18. The effectiveness of overbanding was shown to be significant on crack sealant performance in earlier studies (Solanki et. al., 2014). The recommended overband width is 3 to 4 in and it should not be more than 1/10 to 3/16 in above the pavement surface. Thick overband contributes to pavement traffic noise and also increases the likelihood of being picked up by snow plows during the winter time.
Figure 18. An example of overband configuration for crack filling (width should be within 3 to 4in)

If crack sealing is chosen as the sealant treatment method for a project, it is recommended to use a combination configuration (reservoir and overband). Using the overband will reduce the amount of sealant failure during the service life and prolong service life of sealant treatment. Some examples of overband application for routed and sealed cracks are shown in Figure 19.

Figure 19. Two examples of overband applications for crack sealing treatment: (a) Poor application of an overband, (b) Proper application of an overband

Low modulus sealants show a recessed shape after installation and cooling process. An example of such configurations is shown in Figure 21. This can increase the pavement traffic noise and cause premature adhesion failure of sealants. To prevent recessed configuration, it is recommended to seal the routed cracks in two steps. First, sealant is injected into the reservoir to fill it up to 2/3 of the rout depth. Then, the rout is sealed with overband application as shown in Figure 21.
Figure 20. Recessed overband configuration due to application of low modulus sealant

Figure 21. Two-step crack sealing to avoid recessed configuration: (a) Flush filling of the reservoir in the first step and (b) Application of overband with filling the remaining part of the reservoir after flush filled sealant gained some stiffness

3.6 Blotting

Sealed cracks require a certain time to be cured (varies for different sealant types but at least 15 minutes) so they will not track under traffic. Blotting is sometimes used if early traffic opening is required. Paper towels, sand, and chemicals are some techniques/materials used for blotting. The effect of chemicals to reduce surface adhesive properties on sealants is unknown. Application of sand particles may increase the amount of debris intrusion into sealant surface which may lead to cohesive failure as the sealant experiences elongation due to crack opening. The application of paper towels may seem to be the least intrusive method for blotting; however, papers may be picked up and scattered by traffic.
REFERENCES


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American Association of State Highway and Transportation Officials, TP 88-10. Evaluation of the Low-Temperature Tensile Property of Bituminous Sealants by Direct Tension Test, AASHTO, Washington, DC, 2010

American Association of State Highway and Transportation Officials, TP 89-10. Measuring Adhesion of Hot-Poured Crack Sealant Using Direct Tension Test, AASHTO, Washington, DC, 2010


## Pavement and Crack Survey Form

### Location and Geometries

<table>
<thead>
<tr>
<th>Location:</th>
<th>Milepost of section:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highway/Road:</td>
<td>Number of lanes:</td>
</tr>
<tr>
<td></td>
<td>Lane width:</td>
</tr>
</tbody>
</table>

### Design, Construction, and Rehabilitation

<table>
<thead>
<tr>
<th>Year of original construction:</th>
<th>Type and year of most recent rehab:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Future rehab plans:</td>
<td></td>
</tr>
</tbody>
</table>

### Climate, Traffic, and Highway Classification

| Average annual precipitation (in): | Material: Thickness: |
| No. days below 32 °F: | Material: Thickness: |
| No. days above 100 °F: | Material: Thickness: |
| Most recent two-way AADT: | Material: Thickness: |
| Percent of trucks (%): | |

### Pavement Cross-Section

(Thickness in inches)

### Pavement Condition

#### 1. Surface rating and ride quality

| Surface rating (1:worst 10:excellent): | Ride quality (IRI): |
| Pavement condition index (PCI): | |

#### 2. Cracking Distress

| Primary crack type/orientation: | Average width (in): |
| Density (lin ft/500-ft section): | Average depth/height (in): |
| Edge deterioration (%): | |
| Cupping?/lipping?/faulting?: | |
| Previous treatment: | |

| Other crack type/orientation | Average width (in): |
| Density (lin ft/500-ft section): | Average depth/height (in): |
| Edge deterioration (%): | |
| Cupping?/lipping?/faulting?: | |
| Previous treatment: | |

#### 3. Other Significant Distresses

| Type: | Density: |
| Type: | Density: |
| Type: | Density: |

---

FigureA-1. Survey form for pavement and cracks evaluation
Figure A-2. Kettle temperature monitoring form
<table>
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<th>Time</th>
<th>Air Temp (F)</th>
<th>Humidity (%)</th>
<th>Work Activity</th>
<th>Section</th>
<th>Remarks</th>
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Figure A-3. Work journal form