UFC 3-270-02
15 March 2001

UNIFIED FACILITIES CRITERIA (UFC)

ASPHALT CRACK REPAIR

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

UNIFIED FACILITIES CRITERIA (UFC)

ASPHALT CRACK REPAIR

U.S. ARMY CORPS OF ENGINEERS (Preparing Activity)

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	**Date**	**Location**
1	16 May 2006	Revised Foreword

The format of this document does not conform to UFC 1-300-1; however, it will be reformatted at the next major revision.

FOREWORD

\1\
The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD(AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request (CCR). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current. /**1**/

AUTHORIZED BY:

DONALD L. BASHAM, P.E.
Chief, Engineering and Construction
U.S. Army Corps of Engineers

DR. JAMES W WRIGHT, P.E.
Chief Engineer
Naval Facilities Engineering Command

KATHLEEN I. FERGUSON, P.E.
The Deputy Civil Engineer
DCS/Installations & Logistics
Department of the Air Force

Dr. GET W. MOY, P.E.
Director, Installations Requirements and Management
Office of the Deputy Under Secretary of Defense (Installations and Environment)

Contents

Chapter 9 Crack Sealing Procedures

Chapter 10 Problem Areas

Acknowledgment

This handbook was prepared by Mr. Carroll J. Smith, U.S. Army Engineer Research and Development Center (ERDC), Vicksburg, MS, and is an update of the 1990 version prepared by Mr. Larry N. Lynch, U.S. Army Engineer Waterways Experiment Station. Funding for this project was provided by the U.S. Air Force Civil Engineer Support Agency (AFCESA/CESC), Tyndall Air Force Base, Florida, and the Naval Facilities Engineering Command (NAVFAC), Norfolk, VA. Monitor at AFCESA/CESC was Mr. Richard Smith, and monitors at NAVFAC were Messrs. Charlie Schiavino and Vince Donnally.

CHAPTER 1

INTRODUCTION

1.1. Scope. This handbook contains information on materials, equipment, and procedures used to clean and seal cracks in asphalt cement concrete pavements. Crack repair problem areas are also presented. Additional information can be found in the references listed in the following paragraph. **AF Records Disposition**. Ensure that all records created by this handbook are maintained and disposed of IAW AFMAN 37-139, "Records Disposition Schedule."

1.2. References.

1.2.1. Department of the Army, Corps of Engineers. (1997). "Sealing of Cracks in Bituminous Pavements," CEGS-02975, Washington, DC.

1.2.2. Department of the Army, Corps of Engineers. (1997). "Bituminous Surface Treatment," CEGS-02745, Washington, DC.

1.2.3. Department of the Army, Corps of Engineers. (1998). "Asphalt Slurry Seal," CEGS-02786, Washington, DC.

1.2.4. Departments of the Army and Air Force. (1987). "Bituminous Pavements-Standard Practice," TM 5-822-8/AFM 88-6, Chapter 9, Washington, DC.

1.2.5. Department of the Air Force. (1983). "Standard Practices for Sealing Joints and Cracks in Airfield Pavements," AFM 88-6, Chapter 7, Washington, DC.

1.2.6. Departments of the Army, Navy, and Air Force. (1995). "Maintenance and Repair of Surface Areas," TM 5-624/NAVFAC MO-102/AFJMAN 32-1040, Washington, DC.

1.2.7. Department of the Navy. (1998). “Coal Tar Seal Coat with Unvulcanized Rubber,” NFGS-02788B, Norfolk, VA.

1.2.8. Department of the Navy. (1998). “Bituminous Surface Treatment,” NFGS-02789B, Norfolk, VA.

1.2.9. Department of the Navy. (1998). “Slurry Seal,” NFGS-02787B, Norfolk, VA.

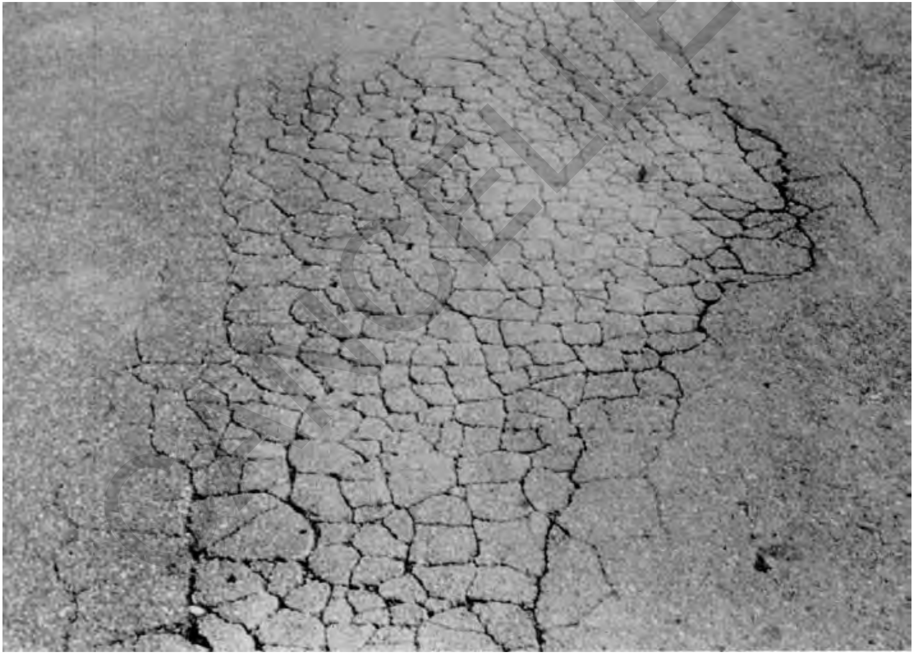
CHAPTER 2

PURPOSE OF SEALING

2.1. Purpose. The purpose of sealing cracks in asphalt concrete pavements is to protect the pavement structure from premature failure. Unsealed cracks allow water intrusion and debris retention in the crack opening. Water intrusion in the cracks penetrates into the base and subbase materials creating the potential problem of a loss of strength in these materials. The weakened pavement structure can result in load-related failures such as alligator cracking (Figure 2.1.). The debris retention can cause the pavement to "push up" at the edges of the crack when the pavement expands due to thermal changes. This decreases the rideability of the pavement surface. These failures and deficiencies increase the life-cycle cost of the pavements by requiring increased maintenance.

2.2. Reduce Maintenance Costs. The use of proper crack preparation and sealing techniques can extend the effective life of the sealant, thereby increasing the life of the pavement and reducing maintenance costs.

Figure 2.1. Example of alligator cracking



CHAPTER 3

WHEN TO SEAL

3.1. Field Evaluation. Field evaluations should be conducted a minimum of twice a year, once during the summer months and once during the winter months. Seasonal evaluations will enable the determination of the number and size of cracks and will allow performance evaluations of any existing sealant when the cracks are at their smallest and largest width. Initial sealing should be considered after cracks have become approximately 1/4 inch (6 millimeters) wide. Cracks less than 1/4 inch (6 millimeters) wide should not be sealed unless they cover approximately 80 percent or more of the pavement. Pavements that have 80 percent or more of the area covered by cracks that are 1/4 inch (6 millimeters) wide or smaller should be sealed using some type of surface treatment (such as a slurry seal), an overlay, or a pavement recycling method.

3.2. Schedule. Crack sealing should be planned and scheduled as determined by field evaluations. Spot repairs should be made to sealed cracks where the sealant material has failed. Figures 3.1. and 3.2. show typical areas in need of sealing. Major resealing projects should be considered for areas where more than 85 percent of the sealant has failed.

3.3. Climate Conditions. Crack sealing projects should be scheduled during the normal construction season. A normally low rainfall period in the spring or fall is preferred. The temperature of the pavement should be 50 degrees Fahrenheit (10 degrees Celsius) and rising, and the crack should be free of moisture and debris before sealing is allowed.

3.4. Porous Friction Surfaces. The guidelines for sealing cracks in a porous friction surface (PFS) are different from a normal asphalt surface. Guidelines provided in paragraph 8.2., AFC 3-270-01, “Asphalt Maintenance and Repair,” should be used for sealing cracks in a PFS.

Figure 3.1. Example of reflective cracking

Figure 3.2. Example of longitudinal cracking

CHAPTER 4

SPECIFICATIONS

4.1. Federal and ASTM. The specifications used to test asphalt crack sealants are as follows:

4.1.1. Federal Specifications (Fed. Spec.)

4.1.1.1. SS-S-1401C	Sealant, Joint, Non-Jet Fuel Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements

4.1.2. American Society for Testing and Materials (ASTM)

4.1.2.1. D 1190-97	Concrete Joint Sealer, Hot-Applied Elastic Type
4.1.2.2. D 3405-96	Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements

4.2. Other. State Department of Transportation (DOT) or local municipality specifications may be used for asphalt rubber and asphalt plus fiber sealants (see Chapter 5).

CHAPTER 5

MATERIAL USES

5.1. Fed. Spec. and ASTM. Crack sealants conforming to Fed. Spec. SS-S-1401C, ASTM D 3405, or ASTM D 1190 can be used to seal cracks in asphalt pavements in any climatic region; however, letter surveys of State DOTs have indicated that Fed. Spec. SS-S-1401C and ASTM D 3405 sealants generally perform better in cooler regions than do ASTM D 1190 sealants. It is recommended that ASTM D 1190 materials not be used in areas that receive a high volume of pedestrian traffic due to the materials' tendency to track onto the pavement and stick to the soles of shoes.

5.2. DOT Spec. Rubberized asphalt sealants that are not covered by the above specifications can be used only when an appropriate State DOT or local municipality material specification is available and after the sealant has been approved by the Facilities Engineer. The DOT and local specifications will often be modified to account for the temperature variations of the region. Asphalt cements that contain synthetic fibers have been used successfully on a limited basis as a crack sealant. State or municipality specifications should also be used for these materials.

5.3. Other. The crack sealant material should be tested by a government-approved independent laboratory for specification conformance before it is used on a project. If the quantity of sealant for the project is less than 500 pounds (227 kilograms), then the manufacturer's certificate of compliance may be accepted in place of testing. The evaluation of local field performance data from past sealing projects is often helpful in determining which type of sealant should be used to seal the cracks.

CHAPTER 6

CRACK PREPARATION EQUIPMENT

6.1. Introduction. The equipment used to prepare a crack for sealing will depend on the size of the crack. Equipment used to prepare a crack will be discussed in this chapter, and the procedures for using the equipment will be discussed in Chapter 7.

6.2. Equipment Inspection. All crack preparation equipment should be inspected before and during actual construction. Inspection will determine if the equipment is being properly maintained, if all of the required safety devices are present, if the equipment is damaging the pavement, and if the equipment is being operated correctly and safely.

6.3. Equipment. Crack preparation equipment includes the following:

6.3.1. Router. A router is used to create a sealant reservoir by enlarging meandering cracks to the desired depth and width. A vertical spindle router with a diamond bit (Figure 6.1.) is recommended to minimize damage to the asphalt pavement; however, an impact router (Figures 6.2. and 6.3.) may be used if it is equipped with carbide-tipped vertical-sided bits. Impact routers that are not equipped with carbide-tipped bits or those equipped with V-shaped bits should not be used because they tend to chip and damage the asphalt pavement. When using a vertical spindle router, the router bit should be belt-driven to help prevent injury to the operator and damage to the pavement if the bit jams in the crack. If damage to the pavement is observed, work should be discontinued until corrective action is taken. Such corrective action may require replacing worn router bits, changing operators, or replacing the equipment completely.

6.3.2. Concrete saw. A concrete saw with a water-cooled diamond blade or abrasive disk can be used to widen straight cracks to the desired width and depth. Concrete saws may be used in place of a router if the blade has a diameter of 6 inches (150 millimeters) or less (Figure 6.4.). The 6-inch- (150-millimeter-) diameter blade allows the saw to follow slightly meandering cracks; however, a saw blade does not follow the meandering crack as well as a router. If a saw is used to widen the crack, a high-pressure water stream can be used to remove the debris created by the saw (Figure 6.5.).

6.3.3. Hot compressed-air (HCA) heat lance. The HCA heat lance (Figure 6.6.) is used to warm, dry, and clean the crack when the sealing operation must be conducted in less than desirable conditions. Such conditions occur following rain or when the pavement temperature is below 50 degrees Fahrenheit (10 degrees Celsius). The heat lance can also be used to remove small amounts of vegetation from cracks. Heat lances are capable of producing heated air at 3,000 degrees Fahrenheit (1,650 degrees Celsius) at velocities of up to 3,000 feet per second (915 meters per second); therefore, extreme care must be used by the operator. The heat lance should not remain stationary over one spot but should be kept moving to ensure that the asphalt pavement is not overheated. Overheating will cause the pavement to become charred and brittle, resulting in premature sealant bond failure. Heating the cracks using direct flame methods should not be permitted. Direct flames harden the asphalt and leave a sooty residue that prevents adequate bonding of the sealant to the asphalt pavement.

6.3.4. Sandblasting equipment. Sandblasting equipment (Figure 6.7.) is used to remove residue left by the saw, loosened aggregate left by the router, vegetation, and other debris. If debris is left in the crack, the sealant will not bond adequately to the asphalt, causing premature failure. Equipment for sandblasting consists of an air compressor, hoses, and a venturi-type nozzle with an opening not to exceed 1/4 inch (6 millimeters). The air compressor should be equipped with traps that will keep the compressed air free of oil and moisture. The compressor should be capable of supplying air at 150 cubic feet per second (4 cubic meters per second) and maintaining a line pressure of 90 pounds per square inch (620 kilopascals). Caution should be exercised to prevent overblasting the crack. It is important to remove all debris from the crack, but overblasting could cause the pavement to ravel or create voids in the crack face.

6.3.5. Wire brushes. Wire brushes (Figure 6.8.) are helpful in removing debris and vegetation from shallow cracks, but they do not easily remove debris, such as saw residue, from the walls of the cracks. Debris on the crack faces will cause the sealant to lose adhesion with the pavement and prematurely fail. Worn brushes should not be used to clean the cracks because they will not effectively remove residual debris. Care should also be taken when wire brushes are used to clean cracks that have been sealed before. The brushes will have a tendency to smear the old sealant residue on the crack wall instead of removing it.

6.3.6. Hand tools. When approved by the Contracting Officer, hand tools may be used for repairing or cleaning cracks or removing old crack sealant. The tools should be examined to ensure that they will not damage the pavement in any manner when properly used.

Figure 6.1. Vertical spindle router

Figure 6.2. Rotary impact router

Figure 6.3. Carbide-tipped rotary impact router bit

Figure 6.4. Concrete saw with a 6-in.- (150-mm-) diameter blade

Figure 6.5. High-pressure water cleaning equipment

Figure 6.6. Hot compressed-air heat lance

Figure 6.7. Sandblasting equipment

Figure 6.8. Wire brush equipment

CHAPTER 7

CRACK PREPARATION PROCEDURES

7.1. Crack Size Guidelines. Crack preparation procedures depend on crack size. The following information should be used as a guide when preparing cracks for sealing.

7.1.1. Hairline cracks (less than 1/4 inch (6 millimeters)). Hairline cracks (Figure 7.1.) require no preparation (see Chapter 9).

7.1.2. Small cracks (1/4 to 3/4 inch (6 to 19 millimeters)). Small cracks (Figure 7.2.) should be widened to a nominal width of 1/8 inch (3 millimeters) greater than the existing nominal or average width. Widening the cracks 1/8 inch (3 millimeters) will help eliminate the potential for raveling of the pavement along the edges of the crack and will provide a sealant reservoir that has vertical faces. The depth of the routed crack should be approximately 3/4 inch (19 millimeters). A backer rod material (see Chapter 9) should be placed in cracks that have a depth greater than 3/4 inch (19 millimeters). Backer rod materials are not required in cracks that are 3/4 inch (19 millimeters) deep.

7.1.3. Medium cracks (3/4 to 2 inches (19 to 50 millimeters)). Cracks that are 3/4 to 2 inches (19 to 50 millimeters) (Figure 7.3.) shall be prepared by simply cleaning the crack using a sandblaster, HCA heat lance, or wire brushes, and then cleaning with compressed air. The crack must be inspected to ensure that it is clean and dry.

7.1.4. Large cracks (greater than 2 inches (50 millimeters)). Cracks wider than 2 inches (50 millimeters) (Figure 7.4.) should be prepared in the same manner as potholes. A saw should be used to cut away damaged pavement to provide vertical faces. The area should then be cleaned and filled instead of sealed (see Chapter 9).

7.1.5. Cracks to be overlayed. Cracks larger than 1/4 inch (6 millimeters) in pavements that are to be overlaid can be prepared by cleaning with the sandblaster, HCA heat lance, or wire brushes and then cleaning with compressed air. Some specifications do not require the sealing of cracks in pavements that are to be overlaid; instead, the cracks are sealed when they reflect through the overlay and therefore require only air cleaning. Large cracks should be prepared as described above.

7.2. Crack Widening. Meandering cracks should be widened using a router; whereas, the straighter cracks can be widened using a saw with a small-diameter blade. When a saw is used, the crack should be cleaned with a high-pressure water stream or a sandblaster to remove debris created by the saw. The recommended procedure is to use a router since water would not be required. When resealing, it is important to remove all of the old sealant that is in the crack. After the crack has been widened or the existing sealant has been removed, the crack should be cleaned to prevent any debris from contaminating the crack.

7.3. Initial Crack Cleaning. Cleaning of the crack can be accomplished by using the sandblasting equipment, the HCA heat lance, or wire brushes. Information relative to this equipment is presented as follows:

7.3.1. Sandblasting equipment. When the sandblasting equipment is used, a technique that enables both faces of the crack to be sandblasted should be established. A multiple-pass technique should be used which consists of positioning the sandblaster nozzle approximately 1 inch (25 millimeters) above the pavement surface, sandblasting the entire length of one crack face, then sandblasting the entire length of the opposite crack face. Approximately 1 inch (25 millimeters) of the pavement surface on both sides of the crack should also be sandblasted to remove debris. The cracks should not be overblasted. Overblasting can damage the pavement, causing raveling and premature bond failure of the sealant.

7.3.2. HCA heat lance. The HCA heat lance should only be used when the pavement is wet and/or cold (pavement temperature below 50 degrees Fahrenheit (10 degrees Celsius)). Extreme care should be used to ensure the crack faces do not become overheated or burned. Overheating of the crack faces can greatly reduce the life expectancy of the sealant and adjacent pavement. The expected failures may be in the form of adhesion failure of the sealant or additional cracking of the pavement between the area that was overheated and the remainder of the pavement.

7.3.3. Wire brushes. Wire brushes are commonly used during sealing projects; however, wire brushes are not always capable of removing debris from the crack faces, and this debris can cause adhesion failures. Careful inspections should be conducted to ensure that the wire brushes are not worn and that all debris and dust have been removed.

7.4. Debris Removal. The recommended procedure to remove debris from the crack is to rout the crack. This method normally removes the debris more effectively with less chance of pavement damage. The rotary impact router equipped with carbide-tipped bits is generally faster than the spindle router. The precautions mentioned previously should always be observed.

7.5. Final Crack Cleaning. Once the old sealant and debris have been removed from the crack, the crack is cleaned with compressed air. The compressed air is blown into the crack to remove sand or any debris that was loosened during the initial cleaning. The compressed air also aids in the removal of moisture.

7.6. Inspection. Inspection is the final phase of crack preparation. The crack must be inspected for cleanliness and dryness. It is essential for the crack to be clean and dry so that the sealant will adhere to the pavement. One method to check for cleanliness is to rub one's finger along the crack face. If a dusty residue is left on the finger, the crack should be recleaned. If there is no residue, the crack is ready for sealing.

7.7. Summary. The cleanliness of the crack is one of the most important factors in crack preparation that affects the life of the sealant. It is not the only important factor, but it is one that can be controlled. After the crack has been inspected and approved for cleanliness, the crack is ready to be sealed (Figure 7.5.).

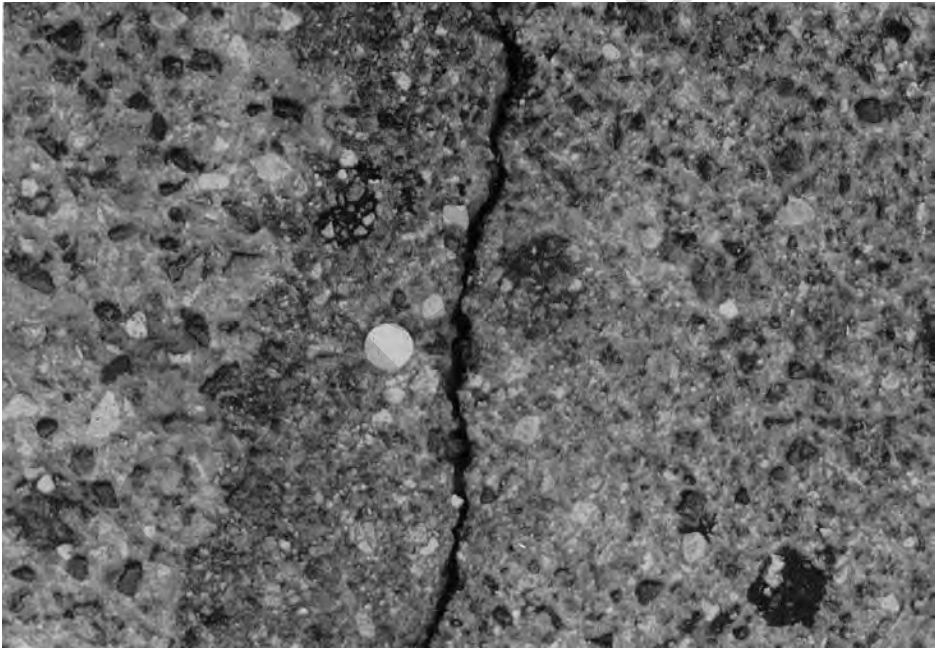
Figure 7.1. Example of hairline-size crack

Figure 7.2. Example of a small-size crack

Figure 7.3. Example of a medium-size crack

Figure 7.4. Example of large-size crack

Figure 7.5. Crack after cleaning



CHAPTER 8

CRACK SEALING EQUIPMENT

8.1. Hot-Applied Sealant Equipment. At the present time, most asphalt pavement crack sealants are hot-applied. If a cold-applied sealant is used, the equipment requirements should be obtained from the sealant manufacturer. Some of the items of equipment used when sealing cracks with a hot-applied sealant are described below:

8.1.1. Hot-applied sealant applicator (melter). The equipment used to heat and install the hot-applied sealant (Figure 8.1.) should consist of a double-boiler, agitator-type kettle. The heat transfer medium in the outer space should be an oil with a high flash point. The double-boiler helps eliminate hot spots in the heating kettle and the agitator provides mixing for uniform heating of the sealant. A direct heating kettle should never be allowed. The sealant should be transferred from the kettle to the crack by means of a direct-connected pressure-type extruding device (hose) with a nozzle that will insert into the crack. The equipment should be designed to allow the sealant to be circulated back into the inner kettle when sealing is not being performed. Positive temperature devices are used to control the temperature of the oil bath and measure the temperature of the sealant. Recording-type thermometers are useful for monitoring the temperature of the sealant in the kettle as work progresses. Recording-type thermometers are not normally installed on the equipment at the manufacturer, but can be installed by the Contractor. The thermometers should be positioned so that they are easily read. Figure 8.2. shows the normal type of thermometers used on the melter.

8.1.2. Handtools. Due to the meandering nature of cracks, handtools are required to insert the backer rod materials in cracks that are deeper than 3/4 inch (19 millimeters). These tools should not twist, cut, or damage the backer rod material.

8.2. Sealant Applicators Not Recommended. Pouring pots or gravity-fed sealant applicators are not recommended for sealing cracks. These applicators have a tendency to trap air in the sealant as it is applied into the crack, creating voids in the sealant. When spot repairs are made to cracks that have been sealed, it may not be feasible to use the hot-applied sealant applicator as described above and pour pots may be used. The pour pot should be equipped with a nozzle that will fit inside the crack in the same manner as the nozzle of the hot-applied sealant applicator.

Figure 8.1. Hot-applied sealant application equipment

Figure 8.2. Thermometers measuring sealant and oil bath temperature

CHAPTER 9

CRACK SEALING PROCEDURES

9.1. Crack Size Guidelines. Procedures for sealing will vary depending upon the size of the crack. The following should be used as a guide.

9.1.1. Hairline cracks (less than 1/4 inch (6 millimeters)). It is very difficult to successfully insert sealant material into a crack that is less than 1/4 inch (6 millimeters). Normally, these cracks are not sealed unless they cover 80 percent or more of the pavement area. If the cracks do require sealing, a surface treatment could be the most effective method. The surface treatment used will depend upon the area being treated and the predicted future traffic. A single or double bituminous surface treatment could be satisfactory for a roadway or parking lot, but not for an airfield. Surface treatments and slurry seals are not recommended for airfields that will encounter jet and high-tire-pressure aircraft because the surface treatment or slurry seal will normally deteriorate quickly. Options such as an asphalt overlay or pavement recycling should be considered for airfield pavements. For additional information on various types of surface treatments, see Department of the Navy, NFGS-02788B, NFGS-02789B, NFGS-02787B; Department of the Army, Corps of Engineers CEGS-02745; or Departments of the Army and Air Force TM 5-822-8/AFM 88-6, Chapter 9.

9.1.2. Small and medium cracks (1/4 to 2 inches (6 to 50 millimeters)). After the crack has been cleaned and inspected, it is ready for sealing. The depth of the cracks to be sealed is determined and, if the depth is greater than 3/4 inch (19 millimeters), a backer rod material is inserted. If the depth of the crack is not deep enough to accommodate the backer rod and maintain a sealant depth of 1/2 to 3/4 inch (13 to 19 millimeters), then the crack can be routed or the backer rod material omitted.

9.1.3. Large cracks (greater than 2 inches (50 millimeters)). Cracks that are 2 inches (50 millimeters) and larger should be filled with a sand asphalt or fine-graded asphalt mix. The procedures and equipment used are identical to those used to repair potholes. The cracks should be squared by sawing, filled with asphalt mix, and compacted. To obtain a high-quality patch, the edges should be vertical and the crack must be clean. The asphalt material could prematurely fail if the proper cleaning and patching procedures are not followed. Additional information on these procedures may be obtained from Departments of the Army, Navy, and Air Force TM 5-624/NAVFAC MO-102/AFJMAN 32-1040.

9.1.4. Cracks in pavements that are to be overlaid. Small and medium cracks in pavements that are to be overlaid can be filled with an emulsion, a sand emulsion mixture (Figure 9.1.), or one of the types of sealants previously mentioned. The material should be recessed in the crack a minimum of 1/4 inch (6 millimeters) to prevent the material from "bleeding" through the overlay. Bleeding occurs when the asphalt cement in the crack sealant material is drawn to the surface of the overlay. Bleeding causes the pavement above the crack to become soft, and a crack in the overlay is usually the end result.

9.2. Backer Rod Material. The backer rod (Figure 9.2.) is a compressible, nonshrinking, nonabsorptive material whose melting point should be higher than the pouring temperature of the sealant. The backer rod should be approximately 25 percent wider in diameter than the nominal width of the crack. The larger size will enable the sealant to be inserted without dislodging the backer rod. The backer rod should be placed to a depth that will provide a shape factor (depth to width ratio) of approximately 1. However, the maximum depth that the backer rod should be placed is approximately 3/4 inch (19 millimeters). This will provide a reservoir for the sealant that will maintain the internal stresses in the sealant at a minimum. High internal stresses can create cohesion failure, a splitting of the material, or dislodge loose aggregate from the pavement, damaging the effectiveness of the seal. However, if the shape factor is too small, adhesion failure can occur; therefore, it is important to maintain the proper shape factor.

9.3. Inspection Prior to Sealing. The cracks should be inspected immediately prior to sealing. This will ensure that the backer rod is at the specified depth and that debris has not been blown back into the crack. Clean cracks are essential in obtaining adhesion between the sealant and the crack face.

9.4. Sealant Temperature and Application. The temperature of the sealant should be checked to make sure it is at the manufacturer's recommended application temperature. The nozzle of the application equipment is inserted into the crack, allowing the crack to be sealed from the bottom to the top (Figure 9-3). Sealing in this manner minimizes bubbling of the sealant due to entrapped air. The sealant should be recessed approximately 1/8 to 1/4 inch (3 to 6 millimeters) below the pavement surface to prevent tracking. A squeegee may be used to remove excess sealant from the pavement surface when a crack is overfilled (Figure 9-4).

9.5. Crack Sealing Delays. Any cracks that are not sealed the same day they are prepared should be blown out with compressed air before the sealing operation continues. If rain delays the sealing operation, the cracks should be allowed to dry and may require additional cleaning to remove any debris that may have been washed into the crack by rain. This debris can be effectively removed by the sandblaster, wire brushes, or HCA heat lance, but not by using only compressed-air cleaning.

9.6. Inspection After Sealing. After the cracks have been sealed (Figure 9.5.), they should be inspected to ensure the sealant is bonding to the pavement and that the cracks were not overfilled. Overfilled material can track onto the pavement surface and/or stick to pedestrians' shoes. The sealant should also be inspected to ensure the proper sealant recess has been obtained. Sealants that have not been recessed may be pushed above the pavement surface as the pavement expands and become damaged by traffic. Cracks that have been underfilled can have additional crack sealant applied.

Figure 9.1. Filling crack with sand emulsion mixture

Figure 9.2. Examples of backer rod materials

Figure 9.3. Sealing the crack

Figure 9.4. Using a squeegee to remove excess sealant

Figure 9.5. A crack after sealing

CHAPTER 10

PROBLEM AREAS

10.1. Categories of Problems. Many problems that arise during a sealing project can be divided into three categories—crack sealant materials, crack preparation, and crack sealant application. The following information is presented for these three sealing problems.

10.1.1. Materials. One of the main problems associated with the sealant materials is nonconformance to the required specification. This problem can be minimized by having the sealant tested by an independent laboratory. Another problem is a combination between materials and application which involves the sealant not setting up or curing once it has been applied to the crack. This problem is often caused by overheating the sealant before it is applied to the crack. The overheating can be caused by heating the sealant at too high a temperature or heating it at the recommended pouring temperature for an extended period of time. Most sealants used to seal cracks in asphalt concrete pavements are asphalt cement based materials, and overheating causes the light volatiles to “cook off” or evaporate. This causes the sealant to become brittle, resulting in premature failure of the sealant. This problem can be solved by monitoring the temperature of the sealant in the application equipment and discarding any material that has been heated for longer than 4 hours. It is also recommended that the sealant remaining in the equipment be discarded and the equipment thoroughly cleaned after each day’s work has been completed.

10.1.2. Preparation. The main problem associated with crack preparation is the cleanliness of the crack. The crack sealant will not adequately bond to the pavement if there is dust, debris, or loose aggregate remaining in the crack. Damaging the pavement during the routing process can also be a problem. Care must be taken by the equipment operator so that each crack is followed and the speed of the router is controlled to prevent the router from jamming in the crack. Careful quality control and inspection can minimize these problems.

10.1.2.1. Checking for dust and debris in the crack is a relatively simple procedure; rub a finger along the crack, and, if the finger gets dusty, the crack is dirty. Checking for moisture is more of a judgment decision. There is no test for checking the moisture of a crack except by observation or feeling with one's hand. It is important that the crack is dry at the time of sealant application so that the sealant will bond to the pavement.

10.1.2.2. The last problem dealing with crack preparation is deciding which method to use. This is a problem because most cracks are not uniform in size and the surrounding pavement will have varying degrees of deterioration. Decisions must be made as work progresses. The main consideration for crack preparation is that the crack be cleaned without damaging the surrounding pavement.

10.1.3. Application. There are two major problems associated with crack sealant application. The first problem, brittleness of the sealant material due to overheating or prolonged heating, was discussed in the "Materials" paragraph. Brittleness is a materials problem because some sealant materials are more susceptible to overheating than others, but it is also an application problem because it can be corrected by implementing a good quality control program. The second problem is overfilling the crack. The sealant can be tracked onto the pavement and abraded if the crack is overfilled. Quality-control measures and inspection can reduce the overfilling of cracks. A squeegee or similar object can be used to remove areas of excess sealant.