CRACK SEALING UTILIZING A HEAT LANCE

Final Report
Project HR-2058

July 1997

Project Development Division

Iowa Department of Transportation

Final Report
for
Research Project HR-2058

CRACK SEALING UTILIZING A HEAT LANCE

By

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8. ABSTRACT

Four Iowa DOT asphalt concrete pavement crack sealing projects were selected to evaluate the benefits of heat lance crack preparation. Two, one-half mile sections, both with and without heat lance preparation, were constructed in Story, Monroe, Clinton and Wayne Counties in 1991 and 1992. They were visually evaluated annually from 1992 through 1996. The heat lance preparation did not yield improved seal performance or extended longevity. There was no perceivable difference between crack sealing with and without heat lance preparation.

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DISCLAIMER

INTRODUCTION

Asphalt concrete pavements have provided good performance in Iowa both on new construction and on resurfacing. In both cases, transverse cracks developed. In new construction the frequency or longitudinal spacing of the transverse cracks is primarily dependent on the temperature susceptibility of the asphalt cement. On resurfacing projects, the transverse cracking is normally due to reflection cracking of the joints or cracks in the underlying pavement.

Water entering the cracks can severely shorten the life or reduce the performance of the asphalt concrete surface. To extend the life of asphalt surfaces, cracks are periodically sealed to prevent ingress of surface water. This preventive maintenance has been accepted as being very cost effective. There is, however, continued efforts to improve the effectiveness of the crack sealing maintenance program.

OBJECTIVE

The objective of this research is to compare the performance of crack sealing with and without heat lance preparation.

PROJECT LOCATIONS AND CONTRACTORS

Four projects were selected to evaluate the benefits of using heat lance preparation.

Story County

The Story County project (MP-35-1(3)106--76-86) was located on I-35 from 3 miles north of IA 210 (MP 105.75) to just north of the US 30 interchange (MP 111.74) (Figure 1).

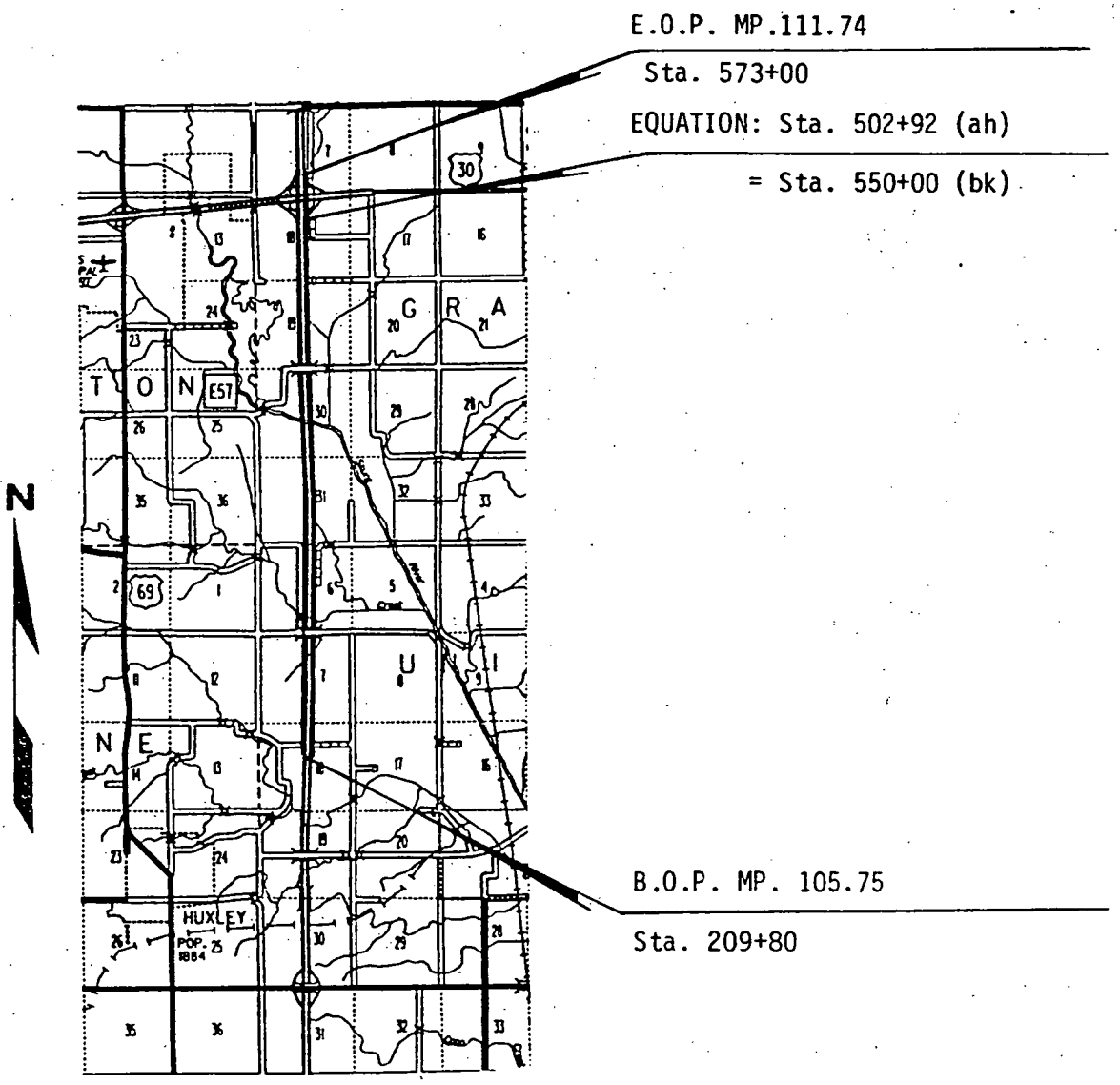

Figure 1 - Story County Project Location

The contractor was Sioux Falls Surface Seal.

Monroe County

The Monroe County project (MP-34-5(5)155--77-68) was located on US 34 from the junction of IA 68 (MP 154.66) easterly to the junction of IA 5 (MP 167.86) (Figure 2).

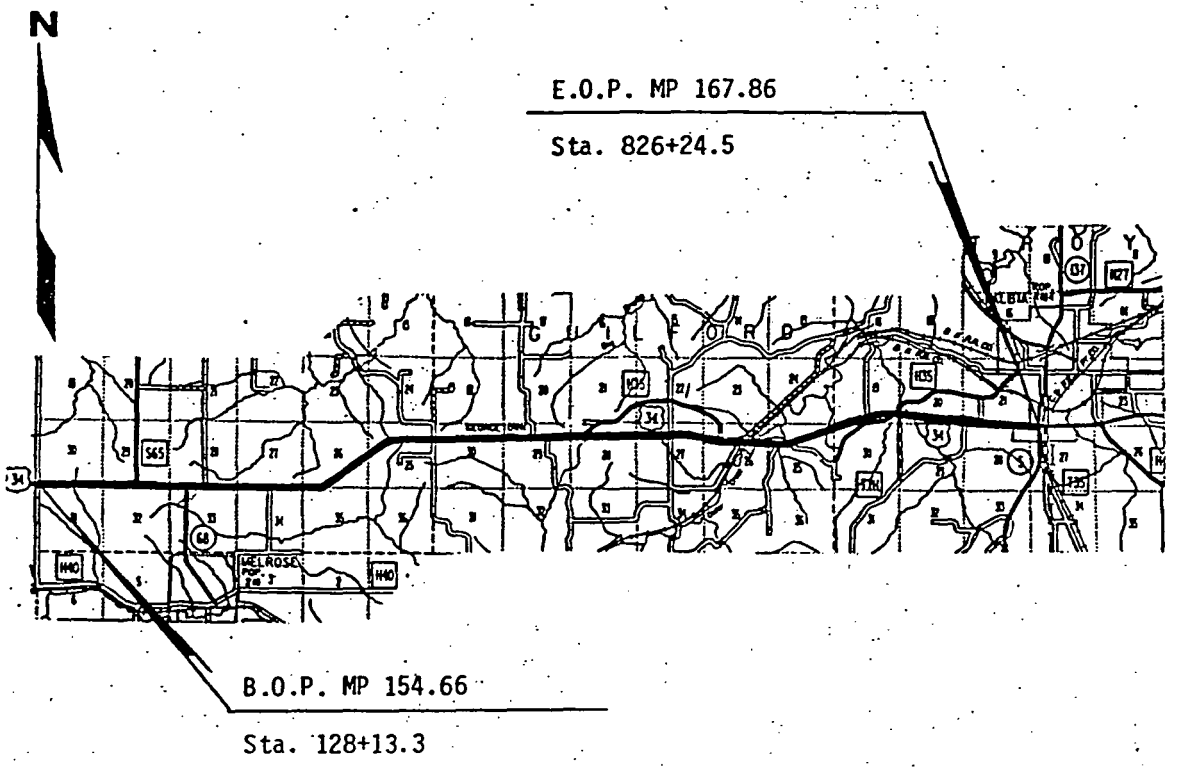

Figure 2 - Monroe County Project Location

The contractor was Illowa Investments, Incorporated.

Clinton County

The Clinton County project (MP-30-6(7)300--76-23) was located on US 30 from 3/4 mile west of Calamus (MP 299.70) easterly to 3/4 mile west of county road Y-62 (MP 309.15) (Figure 3).

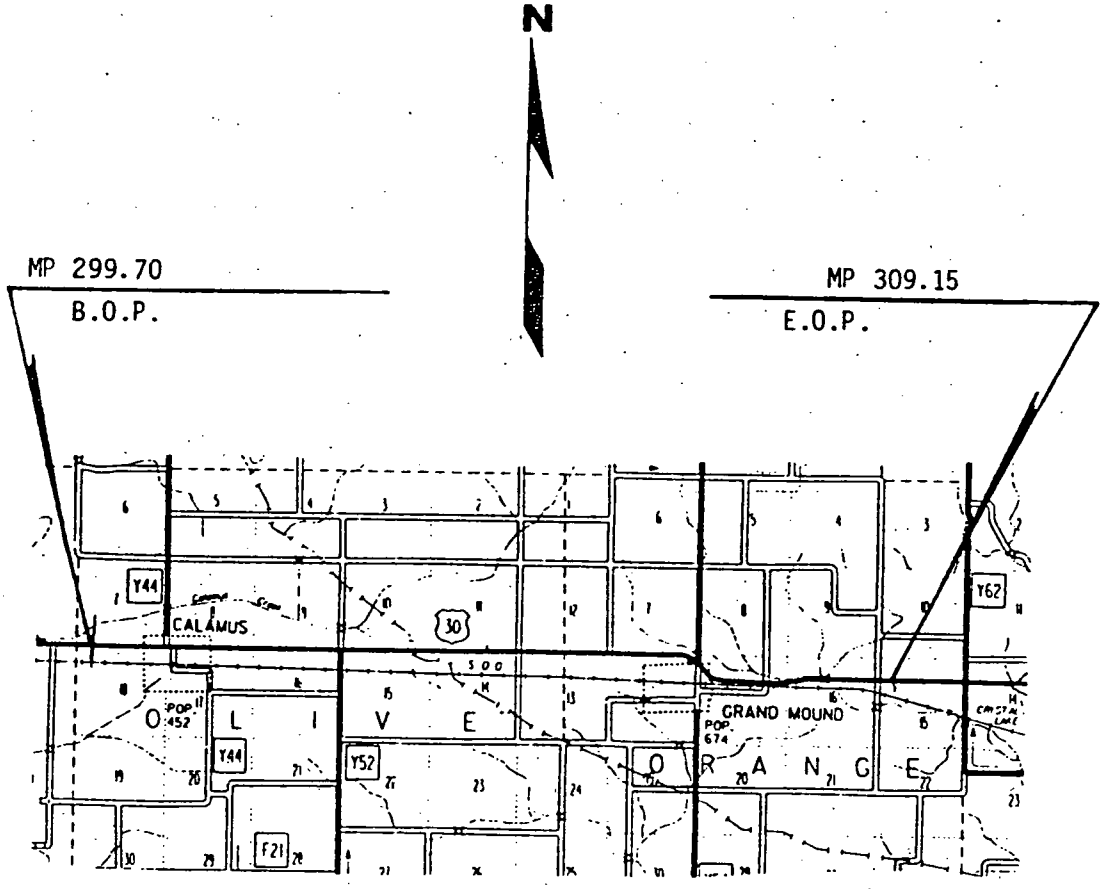

Figure 3 - Clinton County Project Location

The contractor was Illowa Investments, Incorporated.

Wayne County

The Wayne County project (MP-2-5(2)148--79-93) was located on IA 2 from Corydon (MP 148.04) easterly to the Appanoose County line (MP 159.26) (Figure 4).

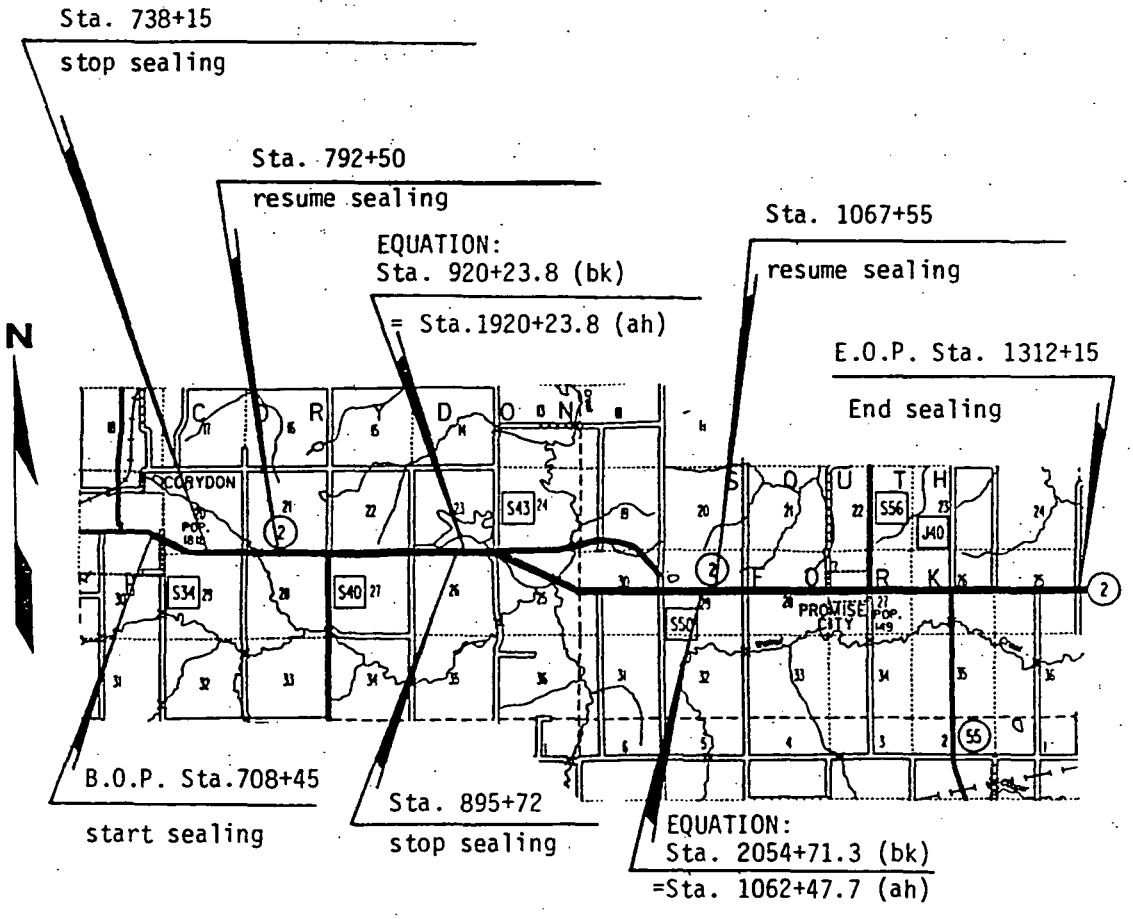

Figure 4 - Wayne County Project Location

The contractor was Sioux Falls Surface Seal.

CRACK SEALING OPERATIONS AND TEST SECTIONS

The conventional Iowa Department of Transportation crack cleaning and sealing is done in accordance with Supplemental Specification SS-5023 (Appendix A). The heat lance crack cleaning, preparation and sealing is done as directed in Special Provision 979 (Appendix B).

Story County

The project began on September 23, 1991 and ended on October 19, 1991. Special Provision 979 did not allow sealing after September 30. The cracks were routed with carbon tipped blades. Loose material was blown from the cracks using a backpack power blower. A 2000° F heat lance was used on two, one-half mile test sections from Station 407+80 (MP 109.5) to 434+20 (MP 110) and 460+60 (MP 110.5) to 485+00 (MP 111) northbound. The one-half mile comparative crack sealing without heat lance sections are Station 381+40 (MP 109.00) to 407+80 (MP 109.50) and Station 434+20 (MP 110.00) to 460+60 (MP 110.50). The contractor sealed the joints with Crafco 21 Hot Pour material at a temperature of 380 to 390°F. The contractor began with a V-shaped rubber squeegee, but changed to a metal squeegee which filled the cracks better.

Monroe County

Field books with a summary of the inspection and the contractor's operation are retained on all Iowa DOT projects. The field book for this project could not be located, so not much

information on the crack cleaning and sealing is available. The sealing was completed between May and September 1992. The heat lance sections on this project were from Station 95+00 (MP 154.5) to Station 146+08 (MP 155) and Station 200+00 (MP 156.5) to Station 251+68 (MP 157). The no heat lance comparative sections were from Station 251+68 (MP 157) to Station 278+08 (MP 157.5) and from Station 146+08 (MP 155) to Station 172+48 (MP 155.5).

Clinton County

The crack cleaning and sealing on this project was done in June and July 1991. The cracks were approximately 1/4 inch wide prior to routing. The heat lance preparation was discoloring about 80 to 90 percent of the crack. The sealing operation was only one or two cracks behind the heat lance operation. The heat lance sections were from MP 301.5 to MP 302 and from MP 303.5 to MP 304. The no heat lance comparative sections were from MP 301 to MP 301.5 and from MP 303 to MP 303.5.

Wayne County

The cracks on this project were approximately 1/4 inch wide prior to routing. Cleaning and sealing on this project was completed in June 1991. The goal with the heat lance was to cause discoloration of about 80% of the routed crack surface. Crafco 231 sealant was used between 380 and 410° F. The experimental heat lance sections were from Station 1066+10 (MP 154.5)

to Station 1092+50 (MP 155) and from Station 1224+50 (MP 157.5) to Station 1250+90 (MP 158). The comparative no heat lance sections were from Station 1092+50 (MP 155) to Station 1118+90 (MP 155.5) and Station 1250+90 (MP 158) to Station 1277+30 (MP 158.5).

A brief summary of the test section locations is given in Table 1 below.

Table 1
Test Section Locations

County & Route	Heat Lance Sections		No Heat Lance Sections	
	Beginning Milepost	Ending Milepost	Beginning Milepost	Ending Milepost
Story I-35	109.5	110	109	109.5
	110.5	111	110	110.5
Monroe - US 34	154.7	155	155	155.5
	156.5	157	157	157.5
Clinton - US 30	301.5	302	301	301.5
	303.5	304	303	303.5
Wayne - IA 2	154.5	155	155	155.5
	157.5	158	158	158.5

VISUAL EVALUATIONS

Visual field reviews were conducted annually on all four projects from 1992 through 1996. The quality of workmanship is very important. There are many places where the routing does

not follow the crack. There were some projects where there was inadequate filling of the joints. A greater application of sealant and use of a squeegee that leaves more sealant on the crack does a more effective job of sealing the crack.

In general, the cracks are well sealed, but there are open cracks where the routing did not follow the crack. The sealing in the wheel paths is in better condition than at the centerline or quarter point. Cracking continues to occur since the sealing in 1991 and 1992, so there is currently a significant amount of unsealed cracks.

There was virtually no difference between the heat lance sections and the comparative no heat lance sections in 1992 on any of the four roadways. There has been no perceivable difference between the heat lance and no heat lance sections on any of the four projects through 1996. The sealant material does remain very soft and pliable.

Maintenance personnel that take care of these roadways did not believe that there was any difference between the heat lance sections and the comparative no heat lance sections.

CONCLUSIONS

This research on crack sealing utilizing heat lance preparation supports the following conclusions.

1. The quality and effectiveness of crack sealing of asphalt concrete paved surfaces is very dependent on good workmanship.

2. Use of a heat lance prior to sealing did not result in an improved seal or extended longevity of the sealing operation.

ACKNOWLEDGMENT

The author wishes to thank Richard Eccles and Harry Fortney who were, at that time, with the Division of Maintenance for their assistance. The help of the Ames, Albia, DeWitt and Corydon Maintenance personnel and the Ames, Ottumwa, Davenport and Chariton Resident Construction Offices was appreciated.

APPENDICES

Appendix A

Supplemental Specification for
Crack Sealing Asphalt Concrete Surfaces

SS-5023
(Replaces SS-1096)

Iowa Department of Transportation

SUPPLEMENTAL SPECIFICATION
for
CRACK CLEANING AND SEALING
(ACC SURFACES)

March 26, 1991

THE STANDARD SPECIFICATIONS, SERIES OF 1984, ARE AMENDED BY THE FOLLOWING ADDITIONS AND MODIFICATIONS. THESE ARE SUPPLEMENTAL SPECIFICATIONS, AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

5023.01 DESCRIPTION.

This work shall consist of routing and cleaning of cracks in the asphalt cement concrete surface and sealing of the prepared cracks with a joint sealer.

5023.02 MATERIALS.

The joint sealer shall be a material meeting requirements of 4136.02A. A hot-pour sealer will be required.

Backer rope used in conjunction with this sealer shall meet requirements of 4136.02C. The rope shall be of a size that compression is required for installation in the crack so it maintains its position during the filling operation, so more than one size may be necessary to complete the work.

5023.03 EQUIPMENT.

A. **Routing or Sawing Equipment** shall be mechanical and power driven, capable of cutting the cracks to the required dimensions. Equipment designed to "plow" the cracks to dimension will not be permitted.

B. Air Compressors shall provide moisture and oil free compressed air and shall be of sufficient size to blow sand and other foreign material from the crack and the pavement surface.

B. **Equipment used for heating and placing the premixed material** shall be of the oil-jacketed, double-boiler type, capable of heating the material to 400 degrees F and pumping the material into the prepared cracks.

5023.04 CONSTRUCTION.

A. **Class I Cracks.** Cracks which have an average opening of 1/2 inch or less shall be routed or sawed to provide a minimum sealant reservoir of 1/2-inch width by a nominal 1-inch depth.

Backer rope may be used. If used, the depth of cleaning and routing or sawing shall be increased, if necessary, and the backer rope shall be placed in the crack to a depth that will provide at least 5/8-inch clearance above the backer rope for the sealer. The backer rope shall be dry when placed.

B. **Class II Cracks.** Cracks which have an average opening greater than 1/2 inch shall be thoroughly cleaned of all foreign material to a depth necessary to accommodate the sealer material and the backer rope to be used. Routing or sawing will be required to develop a minimum 1/2 inch reservoir on portions of cracks that have less than 1/2 inch opening. Backer rope shall be placed in the crack to a depth that will provide at least 5/8-inch clearance above the backer rope for the sealer. The backer rope shall be dry when placed.

C. **Prior to opening to traffic,** asphalt cement concrete and foreign material resulting from crack preparation shall be removed from the roadway by brooming, compressed air, or other methods satisfactory to the Engineer.

D. **Cracks shall be clean and dry prior to sealing.** The entire crack reservoir shall be slightly overfilled with sealant and tightly squeegeed with a narrow V-shaped squeegee, immediately after placement of the sealant, and while still hot. The squeegee shall be operated within approximately 1 foot of the wand tip used to place the sealant. Sealant on the roadway surface in excess of 1/2 inch on each side of the crack edge will not be acceptable.

E. Sealer material shall be heated, handled, and applied according to the manufacturer's recommendations.

5023.05 LIMITATIONS.

Crack cleaning and sealing shall be done only when the ambient air and pavement surface temperatures are above 40°F. When near this minimum, additional air blasting or drying time or both may be necessary to assure a satisfactory bond to the crack surfaces. Crack sealing after September 30 will not be allowed.

The work shall be conducted on only one lane of the pavement width at a time. When work encroaches on an adjacent lane, a flagger will be required at that location.

The work schedule shall be adjusted so that all barricades and equipment are removed from the roadbed from 30 minutes before sunset to 30 minutes after sunrise. No work will be permitted on Sundays or holidays described in 1108.03.

Article 1107.08 and 1107.09 shall apply.

Lanes may be opened to traffic only after the sealer has set sufficiently so it will not pick up under traffic. Powder may be applied to the sealer, but only after the sealer surface has set so as to avoid penetration of the powder into the sealer.

Debris and saw slurry or dust from dry-sawing or routing operations shall be removed from the pavement surface before the pavement is opened to traffic. Dry-sawed or routed joints or cracks shall be cleaned with a stream of air sufficient to remove all dirt, dust, and deleterious material that can adhere to the joint face before the pavement is opened to traffic. This work shall be done within three hours after the joint or crack has been dry-sawed or routed.

Wet-sawed joints shall be cleaned with high pressure water immediately after sawing to remove residue produced by the sawing operation.

Cracks shall be sealed within 3 working days after preparation.

5023.06 METHOD OF MEASUREMENT.

The Engineer will compute the lengths of Class I and Class II cracks satisfactorily cleaned and sealed. The lengths of transverse cracks will be computed from a count of these cracks and the nominal pavement width. Center line cracks will be computed as a straight line from the beginning to the end of joint cleaning and sealing. Random cracks cleaned and sealed will be measured along the actual length.

5023.07 BASIS OF PAYMENT.

A. **Class I Routing and Sealing** will be paid for at the contract price per linear foot.

Payment shall be full compensation for all labor, equipment, materials, and incidentals required for crack routing, cleaning, and furnishing and placing sealant.

B. **Class II Cleaning and Sealing** will be paid for at the contract price per linear foot. Payment shall be full compensation for all labor, equipment, materials, including backer rope, and incidentals required for crack routing, cleaning and furnishing and placing sealant.

Appendix B

Special Provision for Crack Sealing
Asphalt Concrete Surfaces Utilizing a Heat Lance

Iowa Department of Transportation

SPECIAL PROVISION
for
CRACK CLEANING AND SEALING

(ACC Surfaces Utilizing Heat Lance)

MP-35-1(3)106--76-85, Story County
MP-34-5(5)155--76-68, Monroe County
MP-30-6(7)300--76-23, Clinton County
MP-2-5(2)148--76-93, Wayne County

March 26, 1991

THE STANDARD SPECIFICATIONS, SERIES OF 1984, ARE AMENDED BY THE FOLLOWING ADDITIONS AND MODIFICATIONS. THESE ARE SPECIAL PROVISIONS, AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

979.01 DESCRIPTION.

This work shall consist of routing and cleaning of cracks in the asphalt cement concrete surface and sealing of the prepared cracks with a joint sealer.

979.02 MATERIALS.

The joint sealer shall be a material meeting requirements of Article 4136.02A. A hot-pour sealer will be required.

Backer rope used in conjunction with this sealer shall meet requirements of Article 4136.02C. The rope shall be of a size that compression is required for installation in the crack so it maintains its position during the filling operation, so more than one size may be necessary to complete the work.

979.03 EQUIPMENT.

A. Routing or sawing equipment shall be mechanical and power driven, capable of cutting the cracks to the required dimensions. Equipment designed to "plow" the cracks to dimension will not be permitted.

   Router bits shall be designed to provide a consistently rectangular sealant reservoir. The use of carbide tipped bits or equivalent shall be required.

B. Air compressors shall provide moisture and oil free compressed air and shall be of sufficient size to blow sand and other foreign material from the crack and the pavement surface.

C. Equipment used for heating and placing the sealant material shall be of the oil-jacketed, double-boiler type, capable of heating the material to 400 degrees F and pumping the material into the prepared cracks.

D. **Heat Lance:** A unit designed and manufactured with the expressed purpose to clean and dry cracks in concrete and asphalt pavements, so no damage to the pavement will occur. The unit shall be designed so that no flame will touch the pavement. The unit shall be mounted on rollers or wheels to maintain the hot air lance at the needed height from the pavement surface to assure uniform heat distribution. The unit shall be capable of producing heated air at a temperature of 2,000^{O} F as rated by the manufacturer's specifications.

979.04 CONSTRUCTION.

A. **Class I Cracks.** Cracks which have an average opening of 1/2 inch or less shall be routed or sawed to provide a minimum sealant reservoir of 1/2-inch width by a nominal 1-inch depth.

Backer rope may be used. If used, the depth of cleaning and routing or sawing shall be increased if necessary, and the backer rope shall be placed in the crack to a depth that will provide at least 5/8-inch clearance above the backer rope for the sealer. The backer rope shall be dry when placed.

B. **Class II Cracks.** Cracks which have an average opening greater then 1/2 inch shall be thoroughly cleaned of all foreign material to a depth necessary to accommodate the sealer material and the backer rope to be used. Routing or sawing will be required to develop a minimum 1/2 inch reservoir on portions of cracks that have less than 1/2 inch opening.

Backer rope shall be placed in the crack to a depth that will provide at least 5/8-inch clearance above the backer rope for the sealer. The backer rope shall be dry when placed.

C. Prior to opening to traffic, asphalt cement concrete and foreign material resulting from crack preparation shall be removed from the roadway by brooming, compressed air, or other methods satisfactory to the Engineer.

D. Cracks or joints shall be clean and dry prior to sealing. Cleaning and crack preparation of the routed or sawed crack or joint shall be with a heat lance. Immediately prior to sealing, the sealant reservior and adjacent 1/2 inch surface on each side or crack shall be cleaned of foreign material and loose particles with a hot compresseed air heat lance. Adjacent cleaning will be determined by a darkened color of this area or as required by the Engineer. At locations where a backer rope is used, the backer rope shall be installed in the crack or joint at the correct depth after cleaning and drying with a heat lance. Following this work, the sealer material shall be placed in the prepared joint or crack. This shall be accomplished by slightly over-filling the reservoir and immediately squeegeeing with a narrow V-shaped squeegee after placement of the sealant. The squeegee shall be operated within approximately one foot of the wand tip used to place the sealant. Sealant on the roadway surface in excess of 1/2 inch on each side of the crack or joint edge will not be acceptable.

The heat lance shall not be used as a means to remove foreign material from the crack or pavement surface.

E. Sealer material shall be heated, handled, and applied according to the manufacturer's recommendations.

979.05 LIMITATIONS.

Crack cleaning and sealing shall be done only when the ambient air and pavement surface temperatures are above 40°F. Crack sealing after September 30 will not be allowed.

The work shall be conducted on only one lane of the pavement width at a time. When work encroaches on an adjacent lane, a flagger will be required at that location.

The work schedule shall be adjusted so that all barricades and equipment are removed from the roadbed from 30 minutes before sunset to 30 minutes after sunrise. No work will be permitted on Sundays or holidays described in Article 1108.03.

Articles 1107.08 and 1107.09 shall apply.

Lanes may be opened to traffic only after the sealer has set sufficiently so it will not pick up under traffic. Powder may be applied to the sealer, but only after the sealer surface has set so as to avoid penetration of the powder into the sealer.

Cracks shall be sealed within 3 working days after initial routing or sawing.

Debris and saw slurry or dust from dry-sawing or routing operations shall be removed from the pavement surface before the pavement is opened to traffic. Dry-sawed or routed joints or cracks shall be cleaned with a stream of air sufficient to remove all dirt, dust, and deleterious matter that can adhere to the joint face before the pavement is opened to traffic. This work shall be completed within three hours after the joint or crack has been dry-sawed or routed. Wet-sawed joints or cracks shall be cleaned with high pressure water immediately after sawing to remove residue produced by the sawing operation.

The Contractor shall provide protective screening if the cleaning operations are capable of causing damage to or interference with traffic in adjacent lanes.

979.06 METHOD OF MEASUREMENT.

The Engineer will compute the lengths of Class I and Class II cracks satisfactorily cleaned and sealed. The lengths of transverse cracks will be computed from a count of these cracks and the nominal pavement width. Centerline cracks will be computed as a straight line from the beginning to the end of joint cleaning and sealing. Random cracks cleaned and sealed will be measured along the actual length.

979.07 BASIS OF PAYMENT.

A. **Class I Routing and Sealing** will be paid for at the contract price per linear foot.

Payment shall be full compensation for all labor, equipment, materials, and incidentals required for utilizing heat lance, crack routing, cleaning, and furnishing and placing sealant.

B. **Class II Cleaning and Sealing** will be paid for at the contract price per linear foot. Payment shall be full compensation for all labor, equipment, materials, including backer rope, and incidentals required for utilizing heat lance, crack routing, cleaning, and furnishing and placing sealant.