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ENGINEERING INSTRUCTION

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

SUBJECT: PAVEMENT PREVENTIVE MAINTENANCE JOINT AND CRACK SEALING/FILLING GUIDELINES

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P. W. TAYLOR, EXECUTIVE DEPUTY COMMISSIONER

As part of the Pavement Management Plan, Commissioner White requested that a pavement joint and crack sealing policy be developed. The Pavement Management Committee was charged with developing the policy and guidelines to implement the policy. Representatives from the Highway Maintenance Division and the Materials Bureau assisted in developing the guidelines.

POLICY

Each Region shall consider sealing and/or filling pavement joints and cracks as a high priority treatment in its annual preventive maintenance program. Due to the nature of the work, resealing joints in existing rigid pavements and sealing cracks in both rigid and flexible pavements should be generally accomplished by contracts, and filling joints and cracks in both rigid and flexible pavements may be accomplished by either Highway Maintenance Forces or contracts. Each Residency shall apply a minimum of 3,000 gallons of crack filling material annually. Candidate projects should be selected using the attached guidelines. If the pavement condition in a Residency is such that 3,000 gallons cannot be used cost effectively, the Resident Engineer shall document these reasons and obtain a criteria exemption from the 3,000 gallon requirement from the Regional Highway Engineer.

GUIDELINES

Attached are guidelines which establish a framework to carry out the policy. It is recognized that there may be a need to deviate from these guidelines in certain circumstances. When those conditions exist, the user should adequately document the basis for the deviation and proceed with the prudent course of action. Also, this is the first edition of these guidelines and it is expected that there will be a need to modify them after a year or so of use. Comments regarding this document, including suggested modifications, are welcomed and should be directed to the Materials Bureau in Albany.

Recommended specifications are attached for all items referenced in the guidelines. Please note that the specifications for the contract items are special specifications beginning with the prefix 18. It is important that the appropriate special specification be inserted into the PS&E by the Region Design Group. The specifications are as follows:

ITEM

18403.7502 Filling Cracks and/or Joints In Pavements Using Fiber Reinforced Asphalt Cement, ASTM D3405, Or ASTM D1190.

18403.7503 Filling Shoulder Joint Between Portland Cement Concrete Pavement And Asphalt Concrete Shoulders.

18403.7504 Sealing Cracks In Asphalt Concrete Pavement, ASTM D3405.

18502.701002 Resealing Transverse Joints In Portland Cement Concrete Pavement, 63 Ft. Pavement Slabs - Silicone Sealant.

18502.702002 Resealing Transverse Joints In Portland Cement Concrete Pavement, 20 Ft. Pavement Slabs - Silicone Sealant.

18502.7401 Resealing Longitudinal Joints In Portland Cement Concrete Pavement.

18502.7601 Sealing Cracks In Portland Cement Concrete Pavement - Silicone Sealant.

The superseded EI 85-28 transmitted a specification for Item No. 18502.442010, Resealing Transverse Joints in Portland Cement Concrete Pavement. This item is now disapproved for future projects and it has been replaced by Item 18502.701002, Resealing Transverse Joints in Portland Cement Concrete Pavement, 63 Foot Pavement Slabs - Silicone Sealant, and Item 18502.702002, Resealing Transverse Joints in Portland Cement Concrete Pavement, 20 Foot Pavement Slabs - Silicone Sealant.

This engineering instruction becomes effective immediately. The specifications may be used in contracts scheduled for the 6/28/90 letting and thereafter.

PAVEMENT PREVENTIVE MAINTENANCE

JOINT AND CRACK SEALING/FILLING GUIDELINES

Scope

These guidelines are intended to guide designers and maintenance engineers in selecting suitable candidate projects and materials for the pavement joint and crack sealing/filling program.

Purpose

Preventive maintenance is a cost effective strategy available to the Department for extending the service life of original pavements or subsequent rehabilitation treatments by applying low cost treatments to pavements when minor distresses appear. Sealing or filling pavement joints and cracks is a preventive maintenance treatment.

The main reasons for sealing or filling pavement joints and cracks are as follows:

1. Sealing, resealing and filling cracks and joints in rigid, flexible and overlaid pavements will eliminate or significantly reduce the amount of incompressible material (deicing sand) which infiltrates into the pavement; it will reduce the amount of the surface water entering the subbase; and thus it will retard pavement deterioration and extend service life.

   Incompressible material retained in rigid pavement joints can lead to slab blow-ups in hot weather due to the lack of room for expansion at the joints. It can also cause flexible pavement to "push up" at the edges of the crack when the pavement expands due to thermal changes. Both of these situations decrease the rideability of the pavement surfaces. Surface water infiltrating through the cracks and joints can penetrate into the base and subbase materials, causing a loss of strength in these materials, and potentially leading to load-related failures.

2. FHWA's FHPM 6-2-4-1, Pavement Management and Design Policy, requires that a state highway agency perform satisfactory pavement maintenance with state funds to qualify for future Federal-aid funds for the rehabilitation or replacement of that pavement. It would be inappropriate for the Department to allow the maintenance of an item such as pavement joints to lapse and jeopardize the receipt of Federal-aid funds.

Definitions

The following definitions apply to both joints and cracks:

Sealing operations - the placement of a high quality flexible material (i.e. silicone) in a joint or crack that has the proper shape factor (sawing may be necessary). Cleaning the joint or crack opening by sand blasting is often required so that the sealer will adhere to both vertical walls of the opening. A bond breaking material is used to prevent the sealer from adhering to the bottom of the reservoir.

Filling operations - the placement of a flexible material in a joint or crack that is prepared by air-blasting the opening to remove debris lodged in the opening. The filler is then poured into the joint or crack. It is not cost effective to use an expensive high quality material (i.e. silicone) or an expensive cleaning operation (i.e. sandblasting) on joints or cracks that are deteriorated beyond a certain limit. Therefore, a lower quality material (i.e. ASTM D1190 or AC20 + Fibers) and cleaning operation (i.e. air blasting) should be applied to these joints and cracks.

Categories of Work

Pavement joint/crack sealing and filling shall consist of the following types of work:

1. Portland Cement Concrete Pavement (Transverse and Longitudinal) Joint Resealing - This work includes one or more of the following: transverse joint resealing, longitudinal joint resealing, and pavement/concrete shoulder joint resealing. Work shall consist of removing the existing defective sealant, sawing the joint (if necessary) to construct a sealant reservoir, sand blasting the reservoir, and sealing the joint with a high quality sealant.

2. Portland Cement Concrete Pavement Crack Sealing - This work includes sawing or routing a sealant reservoir over the crack, cleaning the reservoir/crack by sand blasting, and sealing the cracks with a high quality sealant.

3. Portland Cement Concrete/Asphalt Concrete Shoulder Joint Filling - This work shall consist of cleaning the opening by air-blasting and filling the joint with a low quality material applied by pouring the filler onto the pavement followed by squeegeeing to a uniform cross section.

4. Asphalt Concrete Pavement Crack Sealing - This work shall consist of constructing a sealant reservoir by sawing or routing over a well defined single crack (a transverse thermal crack for example), cleaning the opening by high pressure air blasting, and sealing the joint with a high quality sealant.

5. Joint and/or Crack Filling - This work shall consist of cleaning debris from the joint or crack opening by air-blasting and filling the opening with a low quality material applied by pouring the filler onto the pavement followed by squeegeeing to a uniform cross section. This is a "band-aide" treatment and should be used on joints and cracks where the distress in the pavement has progressed beyond the condition suitable for sealing operations.

Joint and Crack Sealing/Filling Warrants

The selection of pavements for joint and crack sealing/filling projects should be based on the general condition of the pavement and the specific condition of the joints and/or cracks. Sealing operations should be limited to pavements and shoulders that are in good condition (free from significant spalling, secondary cracking, raveling, etc.) except for joints and/or cracks that can be sealed; and sealing should be used only when the life of the sealant will not exceed the expected life of the pavement surface being treated. Filling operations should be used for pavements where the amount of distress makes them unsuitable candidates for sealing, but a short term preventive maintenance treatment is desired.

Materials and Repair Techniques

Appendix 1 contains details on recommended materials, repair techniques, preferred application times, item numbers, estimated unit cost, and estimated service life for each category of work described above. Regional estimated unit costs for the recommended items should be substituted whenever available. These details provide general information for selecting candidate projects.

Project Selection

The selection of a project is a two step process. The first step is to establish a pool of candidate projects based on the age and condition of the pavement; and the second step is to prioritize the candidate projects in the order which provides for the most cost effective use of preventive maintenance funds. Guidelines for the two steps are outlined as follows:

1. Establishing Candidate Projects - Candidate projects may be identified by age and/or condition as follows:

   Age Criteria (applies only to portland cement concrete pavements):

   Original portland cement concrete pavements should be screened by age using the following criteria:

   Historical data on the performance of joint sealers in PCC pavement show that the effective life of the transverse sealers has been 8 years and the longitudinal sealers between lanes has been 16 years. Based on these established trends, sealing operations should be scheduled at intervals of 8 years as follows:

   1st interval (8 years) - transverse joints and cracks

   2nd interval (16 years) - transverse joints, longitudinal joints between lanes and concrete shoulders, and cracks

   3rd interval (24 years) - Requires assessment of pavement and joint condition. Normal expected life of PCC pavement is 25-30 years.

   Condition Criteria:

   Highway Maintenance Resident Engineers should identify other potential candidates based on the condition criteria described under "Joint and Crack Sealing/Filling Warrants" above.

   Following the identification of potential candidate projects using age and condition criteria, a validation survey of each candidate project should be conducted by Regional Materials Unit personnel to finalize the list of these projects.

2. Project Prioritization (Resource Allocation)

The purpose of preventive maintenance work, described by these guidelines, is to prevent the premature deterioration of pavements and to ensure that the design service life of the pavement is obtained. Resource allocation and prioritization of work should follow the order listed below to provide the greatest cost effectiveness.

Prioritization Order

1 - Portland Cement Concrete Pavement Sealing (Transverse Joints, Longitudinal Joints, and Cracks)

2 - Asphalt Concrete Pavement Crack Sealing

3 - Portland Cement Concrete/Asphalt Concrete Shoulder Joint Filling

4 - Joint/Crack Filling - General

Within the prioritization order, the sub-priorities should be established based on age and traffic volume to determine the most cost effective candidates. Generally, young pavements with high traffic volumes composed of large truck percentages would be the most cost effective candidates.

APPENDIX 1

PAVEMENT JOINT/CRACK MAINTENANCE DETAILS

Category of Work: PCC Pavement (Transverse & Longitudinal) Joint Resealing

Funding Source: Maintenance by Contract

Recommended Materials: Silicone (Approved List)

Character of Work:
- Remove existing joint sealant.
- Additional width sawcut, if required.
- Sandblast each wall of the sealant reservoir.
- Air blast each wall of the sealant reservoir.
- Place backer rod to the proper depth.
- Extrude sealant into the sealant reservoir such that the sealant is 1/8" below the surface of the pavement.
- Tool sealant, if required.

Preferred Application Time: Summer Season

Item Nos:
18502.701002 - Transverse - 63' slabs
18502.702002 - Transverse - 20' slabs
18502.7401 - Longitudinal

Estimated Unit Cost: $2.60/FT (material and application only)

Estimated Service Life: 8+ Years

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Category of Work: PCC Pavement Crack Sealing

Funding Source: Maintenance by Contract

Recommended Materials: Silicone (Approved List)

Character of Work:
- Sawcut a sealant reservoir over the the crack - only cracks 1/8" but 1/2" need be sawn. Cracks 1/8" will not be sealed.
- Sandblast both faces of the sealant reservoir.
- Backer rod may be used at the contractors discretion.
- Extrude sealant into crack/reservoir such that the top of the sealant is 1/8" below the surface of the pavement.
- Tool sealant, if required.

Preferred Application Time: Summer season

Item No: 18502.7601

Estimated Unit Cost: $2.70/FT (material and application only)

Estimated Service Life: No estimate of service life due to limited number of jobs completed using this material. However, it is expected that a service life similar to PCC joint resealing will result.

PAVEMENT JOINT/CRACK MAINTENANCE DETAILS

Category of Work:	PCC/ACC Shoulder Joint Filling
Funding Source:	- Highway Maintenance - Primarily - Some Maintenance by Contract
Recommended Materials:	ASTM D3405 (OGS contract) ASTM D1190 (OGS contract) AC 20 + Fibers (OGS contract)
Character of Work:	- Air blast debris from joint. Hot air lance may be used for this operation. - Pour filler over joint. - Squeegee filler such that a band of filler 1/8" high and 4" wide is left on the pavement/shoulder.
Preferred Application Time:	Spring or fall seasons
Item Nos:	18403.7503
Estimated Unit Cost:	$0.60/FT - (material and application only) Highly variable dependent on crack characteristics
Estimated Service Life:	2+ Years

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Category of Work:	ACC Pavement Crack Sealing (Primarily for Thermal cracks)
Funding Source:	- Maintenance by Contract - Primarily - Some work could be performed by Highway Maintenance
Recommended Materials:	ASTM D3405 (Approved List - OGS Contract)
Character of Work:	- Sawcut a sealant reservoir over the the crack - only cracks 1/8" but 1/2" need be sawn. Cracks 1/8" will not be sealed. - Air blast debris from joint. Hot air lance may be used for this operation. - Pour filler over joint. - Squeegee filler such that a band of filler 1/8" high and 4" wide is left on the pavement/shoulder.
Preferred Application Time:	Spring or fall seasons
Item No:	18403.7504
Estimated Unit Cost:	$2.20/FT (material and application only)
Estimated Service Life:	5+ Years

PAVEMENT JOINT/CRACK MAINTENANCE DETAILS

Category of Work:	Joint/Crack Filling - General
Funding Source:	- Highway Maintenance - primarily - Some Maintenance by Contract
Recommended Materials:	ASTM D3405 (OGS Contract) ASTM D1190 (OGS Contract) AC 20 + Fibers (OGS Contract)
Character of Work:	- Air blast debris from crack. Hot air lance may be used for this operation. - Pour filler over crack. - Squeegee filler such that a band of filler 1/8" high and 4" wide is left on the pavement.
Preferred Application Time:	Spring or fall seasons
Item Nos:	18403.7502
Estimated Unit Cost:	$.60/FT - (material and application only) Highly variable dependent on crack characteristics.
Estimated Service Life:	2+ Years

ITEM 18403.7502 - FILLING CRACKS AND/OR JOINTS IN PAVEMENTS USING FIBER REINFORCED ASPHALT CEMENT, ASTM D3405, OR ASTM D1190

ITEM 18403.7503 - FILLING SHOULDER JOINT BETWEEN PORTLAND CEMENT CONCRETE PAVEMENT AND ASPHALT CONCRETE SHOULDERS

DESCRIPTION

This work shall consist of cleaning and filling cracks and/or joints in existing rigid, flexible, or overlaid pavements, with fiber reinforced asphalt cement, ASTM D3405, or ASTM D1190. The same shall apply for filling the shoulder joint between portland cement concrete pavement and asphalt concrete shoulders.

NOTE: In this specification, the word "joint" may be substituted for the word "crack" wherever it appears.

MATERIALS

The materials used shall meet the following requirements:

Fiber Reinforced Asphalt Cement

Asphalt Cement: The asphalt cement shall be paving grade asphalt supplied by a primary source as defined in Section 702 and meeting the following specification.

Materials Designation	Viscosity Grade
702-0500	AC-20

Fibers: The fibers shall meet the following requirements:

Type of Fiber: Polyester
Tensile Strength: 70 ksi min.
Specific Gravity: 1.32-1.40
Melt Temperature: 475°F min.
Elongation: 33% ± 9%
Length of Fiber: .25 in ± .03 in

Each container shall be legibly marked with the following information:

Manufacturer's Name
Trade Name of Fiber
Type of Fiber

Composition of Sealant Mixture: The following asphalt cement and fiber proportions shall apply.

Asphalt Grade	Minimum % Fiber by Weight of Asphalt
	Polyester
AC20	5.0

ITEM 18403.7502 - FILLING CRACKS AND/OR JOINTS IN PAVEMENTS USING FIBER REINFORCED ASPHALT CEMENT, ASTM D3405, OR ASTM D1190

ITEM 18403.7503 - FILLING SHOULDER JOINT BETWEEN PORTLAND CEMENT CONCRETE PAVEMENT AND ASPHALT CONCRETE SHOULDERS

Mixing Temperatures: The filler shall be mixed at the temperatures recommended by the fiber manufacturer but shall in no case exceed 325°F.

ASTM D3405.

The filler shall meet the requirements of ASTM D3405. The filler shall be delivered in the manufacturer's original sealed containers. Each container shall be legibly marked with the following information.

Manufacturer's name
Trade name of the filler
Manufacture's lot or batch number
Pouring temperature
Safe heating temperature

ASTM D1190.

The filler shall meet the requirements of ASTM D1190. The filler shall be delivered in the manufacturer's original sealed containers. Each container shall be legibly marked with the following information.

Manufacturer's name
Trade name of the filler
Manufacture's lot or batch number
Pouring temperature
Safe heating temperature

BASIS OF ACCEPTANCE

Fiber Reinforced Asphalt Cement

Acceptance of the bituminous material is based on the name of the primary source appearing on the Department's Approved List of Asphalt Cement for Paving and is contingent upon certification of compliance to these specification requirements by the primary source and subsequent suppliers.

Acceptance of the polyester fibers is based on certification by the manufacturer that the fibers meet the material properties listed under MATERIALS.

ASTM D3405

Acceptance of the joint sealant is based on the brand name labeled on the container and the brand name and supplier appearing on the current Approved List titled Highway Joint Sealant (ASTM D3405). The Department reserves the right to conduct supplementary sampling and testing.

ITEM 18403.7502 - FILLING CRACKS AND/OR JOINTS IN PAVEMENTS USING FIBER REINFORCED ASPHALT CEMENT, ASTM D3405, OR ASTM D1190

ITEM 18403.7503 - FILLING SHOULDER JOINT BETWEEN PORTLAND CEMENT CONCRETE PAVEMENT AND ASPHALT CONCRETE SHOULDERS

ASTM D1190

Acceptance of the filler is based on certification by the manufacturer that the material meets the requirements of ASTM D1190. The Department reserves the right to conduct supplementary sampling and testing.

CONSTRUCTION DETAILS

General. The Contractor shall furnish all equipment necessary for cleaning and filling the pavement cracks. All equipment shall be approved by the Engineer before its use.

Filling shall be done at locations shown on the Plans or as directed by the Engineer.

All cracks shall be thoroughly cleaned of all dust, dirt, moisture, foreign material, incompressibles or any other extraneous materials by high pressure air, hot air lance, wire brush or other suitable method or tool approved by the Engineer. The cracks shall be cleaned a minimum of 3/4" deep. The material and debris removed from the crack shall be removed from the pavement to prevent re-contamination of the crack.

Immediately prior to filling and after the crack has been prepared as specified above, both crack faces shall be thoroughly cleaned to a minimum depth of 1/2" using compressed air. The crack sides shall appear thoroughly clean and dry prior to filling. The Contractor may be ordered to reclean cracks if in the opinion of the Engineer adequate cleaning and drying is not being obtained. Final cleaning or recleaning may be performed with the use of a hot air lance. When using a hot air lance, care shall be taken so as not to burn, scorch, or ignite the adjoining pavement. Suitable traps or devices shall be installed on the compressed air equipment to prevent moisture and oil from contaminating the crack surfaces. The Contractor shall maintain these devices and see that they are functioning properly. Any cracks not filled the same day shall be recleaned prior to filling.

The Contractor shall be responsible for protecting traffic and property from hazard or damage during the crack cleaning operation. Materials and methods used for this purpose will be subject to the approval of the Engineer.

The filler shall be heated in a melter constructed either as a double boiler, with the space between inner and outer shells filled with heat-transfer medium; or with internal tubes or coils carrying the filler through a heated oil bath and into a heated double wall hopper. Direct heating shall not be used. Positive temperature control, mechanical agitation and recirculation pumps shall be used. The unit shall be provided with separate thermometers to indicate the temperature of the heat transfer medium and the filler material in the hopper. The mixing unit shall be capable of maintaining the specified mixing temperature, with an allowable variation of

±10°F. Before any crack filling shall commence, the Engineer shall inspect the filling apparatus to ascertain the presence and working condition of the thermometers. Under no circumstances will the Engineer permit any crack filling if thermometers are found to be defective or missing.

The Contractor shall be responsible for a safe and efficient method by which the Engineer will be able to accurately measure the temperature of the filler as it is discharged from the applicator wand. The proposed method must be submitted to the Engineer for his approval before the commencement of crack filling operations. The Contractor shall provide the Engineer with two (18" stem) thermometers having a temperature range sufficient to meet the requirements of this specification.

The discharge hose shall be equipped with a controlled heating apparatus or shall be insulated sufficiently to maintain the proper filler temperature. The application wand shall be returned to the machine and the material recirculated as necessary to maintain the proper filler application temperature between individual crack filling operations.

If in the opinion of the Engineer, the Contractor displays an inconsistency in his ability to perform the cleaning or filling operation, he shall order the Contractor to cease his operations until such time as he can comply with the required criteria in a consistent manner.

For Fiber Reinforced Asphalt Cement Only

The contractor shall obtain the manufacturer's recommendations pertaining to the heating, mixing, and application of the filler, and shall supply a copy to the Engineer. These recommendations shall be adhered to and followed by the contractor with such exceptions as this specification may require.

The filler shall not be placed when pavement or ambient temperatures fall below 40°F. The filler shall be pumped directly into the crack or joint from the mixing unit. The filler shall overlay the crack at the pavement surface. The height of the filler above the pavement surface shall not exceed 1/8".

Blotting with fine aggregate shall directly follow filler application if traffic results in tracking of the crack filling material.

For cracks exceeding a width of 3", Size 1A coarse aggregate meeting the requirements of Section 703-02 shall be added into the filler material.

For ASTM D3405 or ASTM D1190 Only

The filler shall not be placed when pavement or ambient temperatures exceed 80°F or fall below 35°F. All cracks must be thoroughly dry and clean at the time of filling.

ITEM 18403.7502 - FILLING CRACKS AND/OR JOINTS IN PAVEMENTS USING FIBER REINFORCED ASPHALT CEMENT, ASTM D3405, OR ASTM D1190

ITEM 18403.7503 - FILLING SHOULDER JOINT BETWEEN PORTLAND CEMENT CONCRETE PAVEMENT AND ASPHALT CONCRETE SHOULDERS

A copy of the manufacturer's recommendations pertaining to the heating and application of the filler shall be submitted to the Engineer prior to the commencement of work. These recommendations shall be adhered to and followed by the Contractor, with such exceptions as this specification may require.

The recommended pouring temperature shall be 10°F below the manufacturer's designated safe heating temperature, with an allowable variation of ±10°F. Filler material that has exceeded the safe heating temperature, been heated at the pouring temperature in excess of 6 hours, or reheated shall not be used.

Cracks shall be filled by slightly overfilling and squeeging the filler to form a band four inches wide and 1/16" to 1/8" thick, with tapered edges, centered over the crack. During the filling operation the distance between the filler application wand and squeegee shall not exceed 2 feet. Traffic shall not be allowed on the filler until it has cured sufficiently to prevent tracking. Blotting with fine aggregate will not be allowed. Filler that becomes damaged or that is installed improperly shall be repaired.

Damaged or deficient areas shall have the filler removed, the surfaces properly cleaned and new filler installed to the satisfaction of the Engineer at the Contractor's expense.

METHOD OF MEASUREMENT

The quantity to be paid for shall be the actual number of gallons of asphalt cement (corrected to 60°F gal) or gallons of filler used to complete the work.

No payment will be made for waste material.

BASIS OF PAYMENT

The unit price bid shall include the cost of all labor, equipment and materials necessary to complete the work.

ITEM 18403.7504 - SEALING CRACKS IN ASPHALT CONCRETE PAVEMENT, ASTM D3405

DESCRIPTION

This work shall consist of sawing, cleaning and sealing cracks in asphalt concrete pavement at locations shown on the plans or where directed by the Engineer.

MATERIALS

Crack Sealant. The sealant shall meet the requirements of ASTM D3405. The sealant shall be delivered in the manufacturer's original sealed containers. Each container shall be legibly marked with the following information.

Manufacturer's name
Trade name of the sealant
Manufacture's lot or batch number
Pouring temperature
Safe heating temperature

BASIS OF ACCEPTANCE. Acceptance of the joint sealant is based on the brand name labeled on the container and the brand name and supplier appearing on the current Approved List titled Highway Joint Sealant (ASTM D3405). The Department reserves the right to conduct supplementary sampling and testing.

CONSTRUCTION DETAILS

General: All pavement repairs called for on the plans which border a pavement crack to be sealed under this item shall be completed, as specified in the appropriate item(s), prior to commencement of the crack sealing operation.

The Contractor shall furnish all equipment necessary for sawing, cleaning, and sealing the pavement cracks. All equipment shall be approved by the Engineer before its use.

Sealing will generally be limited to opened cracks at least 1/8 inch wide at locations shown on the plans or where directed by the Engineer. Cracks with varying widths, portions of which are 1/8 inch wide or over, should be sealed along their entire length.

Crack Preparation: All cracks less than 1/2 inch wide shall be sawn in areas shown on the contract plans or where directed by the Engineer. Cracks 1/2 inch and wider shall have a saw run through them to ensure that the crack has a depth equal to or greater than the width.

Sawing shall be accomplished with crack sawing equipment which shall produce vertical sides with a minimum of edge spalling. Other types of equipment, such as vertical spindle type routers, may be approved by the Engineer if satisfactory results are obtained as determined by the Engineer. For cracks less than 1/2 inch wide, the sawed recess shall have the approximate dimensions of 1/2 inch wide by 1/2 to 5/8 inch deep.

All cracks shall be thoroughly cleaned of all dust, dirt, foreign material, incompressibles or any other extraneous materials by high pressure air, hot air lance, plow, saw, wire brush, or other suitable method or tool approved by the Engineer. The material and debris removed from the crack shall be removed from the pavement to prevent recontamination of the crack.

Immediately prior to sealing and after the crack has been prepared as specified above, both crack faces shall be thoroughly cleaned to a minimum depth of 1/2" using compressed air. The crack sides shall be thoroughly clean and dry prior to sealing. The Contractor may be ordered to reclean cracks, if in the opinion of the Engineer, adequate cleaning and drying is not being obtained. Final cleaning or recleaning may be performed with the use of a hot air lance. When using a hot air lance, care shall be taken so as not to burn, scorch or ignite the adjoining pavement. Suitable traps or devices shall be installed on the compressed air equipment to prevent moisture and oil from contaminating the crack surfaces. The Contractor shall maintain these devices and see that they are functioning properly. Any cracks not sealed the same day shall be recleaned prior to sealing.

The Contractor shall be responsible for protecting traffic and property from hazard or damage during the crack cleaning operation. Materials and methods used for this purpose will be subject to the approval of the Engineer.

Sealing. The sealant shall not be placed when pavement or ambient temperatures exceed 80°F or fall below 35°F. All cracks must be thoroughly dry and clean at the time of sealing.

A copy of the manufacturer's recommendations pertaining to the heating and application of the sealant shall be submitted to the Engineer prior to the commencement of work. These recommendations shall be adhered to and followed by the Contractor, with such exceptions as this specification may require.

The sealant shall be heated in a melter constructed either as a double boiler, with the space between inner and outer shells filled with heat-transfer medium; or with internal tubes or coils carrying the sealant through a heated oil bath and into a heated double wall hopper. Direct heating shall not be used. Positive temperature control, mechanical agitation and re-circulation pumps shall be used. The unit shall be provided with separate thermometers to indicate the temperature of the heat transfer medium and the sealant material in the hopper. Before any crack sealing shall commence, the Engineer shall inspect the sealing apparatus to ascertain the presence and working condition of the thermometers. Under no circumstances will the Engineer permit any crack sealing if thermometers are found to be defective or missing.

The Contractor shall be responsible for a safe and efficient method by which the Engineer will be able to accurately measure the temperature of the sealant as it is discharged from the applicator wand. The proposed method must be submitted to the Engineer for his approval before the commencement of crack sealing operations. The Contractor shall provide the Engineer with two (18" stem) thermometers having a temperature range sufficient to meet the requirements of this specification.

The discharge hose shall be equipped with a controlled heating apparatus or shall be insulated sufficiently to maintain the proper sealant temperature. The application wand shall be returned to the machine and the material recirculated as necessary to maintain the proper sealant application temperature between individual crack sealing operations.

The recommended pouring temperature shall be 10°F below the manufacturer's designated safe heating temperature, with an allowable variation of ±10°F. Sealant material that has exceeded the safe heating temperature, been heated at the pouring temperature in excess of 6 hours, or reheated shall not be used.

Cracks shall be sealed by slightly overfilling and squeegeeing the sealant to form a band four inches wide and 1/16" to 1/8" thick, with tapered edges, centered over the crack. During the sealing operation the distance between the sealant application wand and squeegee shall not exceed 2 feet. Traffic shall not be allowed on the sealant until it has cured sufficiently to prevent tracking. Blotting with fine aggregate will not be allowed. Sealant that becomes damaged or that is installed improperly shall be repaired. Damaged or deficient areas shall have the sealant removed, the surfaces properly cleaned and new sealant installed to the satisfaction of the Engineer at the Contractor's expense.

If in the opinion of the Engineer, the Contractor displays an inconsistency in his ability to perform the cleaning or sealing operation, he shall order the Contractor to cease his operations until such time as he can comply with the required criteria in a consistent manner.

METHOD OF MEASUREMENT

This work shall be measured by the number of linear feet of cracks sealed.

BASIS OF PAYMENT

The unit price bid per linear foot shall include the cost of furnishing all labor, equipment and materials to complete the work.