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PART II - CONSTRUCTION MATERIALS AND METHODS
SECTION 12

SURFACE TREATMENTS

12.1 GENERAL

The work shall consist of applying slurry seal, micro-surface, chip seal, hot chip seal or crack sealant material to residential and collector pavements in accordance with these Specifications. The pay item for seal coats and crack seal shall include surface preparation, notification, traffic and parking control, mobilization and all other work not specified as separate pay items. These Specifications shall apply to all new construction within the City of Arvada.

12.2 MATERIALS

12.2.1 Slurry Seal Asphalt Emulsion

The emulsified asphalt shall be a quick setting, cationic type conforming to the requirements of ASTM specification for CQS-1hL (latex polymer modified) emulsion. Polymer modified asphalt emulsion shall contain 1.0%, by weight, of styrene-butadiene rubber (SBR) polymer solids by weight of residual asphalt. Residual asphalt shall range between 7.5 and 13.5 percent by weight to dry aggregate.

12.2.2 Tack Coat for Slurry Seal and Micro-surfacing

Tack coat shall be CSS-1h emulsified asphalt thinned to a mixture of one part emulsified asphalt and three parts potable water.

12.2.3 Micro-surfacing Asphalt Emulsion

The emulsified asphalt shall be a quick setting, cationic type conforming to the requirements of ASTM specification for CQS-1hP (latex polymer modified) emulsion. Polymer modified asphalt emulsion shall contain 3.0% to 3.5%, by weight, of styrene-butadiene rubber (SBR) polymer solids by weight of residual asphalt. Residual asphalt shall range between 7.5 and 13.5 percent by weight to dry aggregate.

12.2.4 Chip Seal Asphalt Emulsion

The emulsified asphalt shall be a rapid setting, cationic type conforming to the requirements of ASTM specification for CRS-2P (latex polymer modified) emulsion. Polymer modified asphalt emulsion shall contain 3.0% to 3.5%, by weight, of styrene-butadiene rubber (SBR) polymer solids by weight of residual asphalt. Residual asphalt shall range between 7.5 and 13.5 percent by weight to dry aggregate.

12.2.5 Hot Cover Coat Asphalt

Asphalt material shall be AC 20 and asphalt content shall be 5.0% to 5.5%.

12.2.6 Fog Seal

The emulsified asphalt shall be a rapid setting, cationic type conforming to the requirements of ASTM specification for CRS-2P (latex polymer modified) emulsion.

Polymer modified asphalt emulsion shall contain 3.0% to 3.5%, by weight, of styrene-butadiene rubber (SBR) polymer solids by weight of residual asphalt. Residual asphalt shall range between 7.5 and 13.5 percent by weight to dry aggregate. Emulsion shall be diluted to one part CRS-2P to one part potable water.

12.2.7 Crack Sealant

Crack sealant shall be Elastoflex 500 as manufactured by Maxwell Products, Inc. or Engineer approved equal. Elastoflex 500 is a polymer modified, hot applied, non-tracking asphalt conforming to the requirements of ASTM D3405 or ASTM D1190. Sealant shall not contain vulcanized or reclaimed rubber.

12.2.8 Slurry Seal and Micro-surfacing Aggregate

Screening of aggregate shall be required at the stockpile prior to delivery to the paving machine. Presence of oversized granular material shall be grounds to stop work on the project until compliance with these Specifications is demonstrated to the Engineer.

Aggregate shall be free of clay lumps and other deleterious material. Presence of clay lumps in the aggregate shall be grounds to suspend operations until compliance with these Specifications is demonstrated to the Engineer.

Mineral fillers such as Portland cement, limestone dust, lime fly ash and others shall be considered as part of the blended aggregate and shall be used in the minimum amount required by the mix design. Mineral filler limits shall be 0.50% to 3% of dry weight of the aggregate. Mineral fillers shall be manufactured in the same year as the project.

Mineral fillers shall be used for the following purposes:

- A. To improve the gradation of the aggregate.
- B. To control the time of break and the set time of the emulsion.
- C. To provide improved stability and workability.
- D. To increase the durability.

12.2.9 Aggregate

Aggregate shall have the following gradation and application rate:

	Slurry Seal	Micro-surfacing	Chip Seal	Hot Cover Coat
	TYPE II	TYPE III		
Sieve Size	Percent Passing	Percent Passing	Percent Passing	Percent Passing
1/2"	-	-	90-100	90-100
3/8"	100	100	0-50	60-90
No. 4	90-100	70-90	0-10	25-35
No. 8	65-90	45-70	0-3	15-25
No. 16	45-70	28-50	-	-
No. 30	30-50	15-35	-	-
No. 50	18-30	10-25	-	-
No. 100	10-21	7-18	-	-
No. 200	5-15	5-10	0-2	3-8
RATE	17-19 LBS/SY	20-25 LBS/SY	20-25 LBS/SY	60-80 LBS/SY

The mineral aggregate shall consist of 100 percent crushed gray granite as supplied by the Asphalt Paving Company quarry at 6959 Highway 93, Golden, Colorado or an approved equal. The aggregate shall have a maximum 15% loss when tested for soundness in accordance with ASTM C88 and a maximum 35% loss when tested for hardness in accordance with ASTM C131.

12.2.10 Water

Water used for the slurry seal and micro-surfacing shall be potable and the amount used shall take into account the moisture content of the aggregate when calibrating the slurry machine to deliver asphalt in the correct proportion.

12.2.11 Mix Design for Slurry Seal and Micro-surfacing

The mix design shall be submitted two weeks prior to start of work. A qualified independent testing laboratory shall prepare the mix design at the Contractor's expense. The mix design shall include sources of all materials and testing data by a qualified laboratory, verifying conformance with these Specifications. Only minor field changes to the mix design will be permitted without retesting and approval by the laboratory preparing the mix design.

The Contractor shall provide a mixture with curing properties that will allow the roadways to be opened within 3 hours of material placement. The amount of asphalt emulsion to be blended with the aggregate shall be that as determined by laboratory mix design subject to final adjustment in the field and the Engineer's approval. A minimal amount of water may be added as necessary to obtain a fluid and homogeneous mixture. The mixture shall be sufficiently stable during the entire mixing-spreading period that the emulsion does not break in the spreader box, that there is no segregation of fines from the coarser aggregate and that the liquid portion of the mix does not float to the surface. The mixture shall be homogeneous during mixing and spreading and free of excess water. The residual asphalt content by dry weight of the aggregate should not vary plus or minus 1.5 percent from the rate determined by laboratory design and final field adjustment.

12.2.12 Mix Design for Hot Cover Coat

The mix design shall be submitted two weeks prior to start of work. A qualified independent testing laboratory shall prepare the mix design at the Contractor's expense. The mix design shall include sources of all materials and testing data by a qualified laboratory, verifying conformance with these Specifications. Only minor field changes to the mix design will be permitted without retesting and approval by the laboratory preparing the mix design.

12.2.13 Crack Sealant Submittals

Sealant material shall be approved by the Project Engineer prior to the start of work. Submittals shall include, but may not be limited to, manufacturer's technical data and testing data by ASTM standards, descriptive information and application instructions. Certified test results by a commercial or State Highway testing laboratory verifying conformance of the material by batch, lot or other identification number to the requirements of the project Specifications may be required.

12.3

CONSTRUCTION PRACTICES

12.3.1

Slurry Seal and Micro-surfacing

A. Equipment - All equipment, tools, and machines used in the performance of this work shall be maintained in satisfactory working order at all times. Descriptive information on the mixing and applying equipment to be used shall be submitted for approval not less than 7 days before the work starts.

1. Mixing Equipment:

The mixing machine shall be a continuous flow mixing unit, capable of delivering accurate predetermined proportions of aggregate, mineral fillers, water and asphalt emulsion to a revolving multi blade mixer tank, and of discharging the thoroughly mixed product on a continuous basis. The machine shall be capable of mixing materials in preset proportions regardless of the speed of the machine engine, and without changing machine settings. The spreader box shall be furnished with a full width burlap drag.

The aggregate shall be pre-wetted immediately prior to mixing with the emulsion. The mixing unit shall be capable of thoroughly blending all ingredients together without violent action. The mixing machine shall be equipped with suitable means of accurately metering each individual material being fed into the mixer, so the machine can be accurately calibrated and that the quantities of material used during any one period can be accurately totaled.

The mixing machine shall be equipped with a water pressure system, and fog type spray bar adequate for completely fogging the pavement surface with up to 0.55 gallons per square yard, immediately ahead of the spreading equipment.

2. Spreading Equipment:

The spreader box shall be equipped to prevent loss of mixture from all sides and shall have a flexible rear strike-off screed. It shall be capable of producing a uniform surface over its full width. The ability to regulate width of placement of new material is a desirable feature. It shall have suitable means for side tracking to compensate for deviations in pavement geometry. Drags shall be kept in a completely flexible condition at all times. The box shall be kept clean and build-up of asphalt and aggregate shall not be permitted.

3. Cleaning Equipment:

Power brooms, power blowers, air compressors, water flushing equipment and hand brooms shall be suitable for cleaning the base pavement surface and cracks therein.

B. Preparation of Surface - The City will be responsible for any pavement repairs, crack filling or necessary tree trimming prior to Contractor's operations. The Contractor shall be responsible for removing vegetation, cleaning cracks larger than 1/4 inch, hand cleaning work and removing loose debris by power sweeping the streets immediately prior to placement of the material.

Immediately prior to applying the material, the Contractor shall notify the Engineer for an inspection and approval that the surface has been prepared properly. The Contractor will be responsible for a properly cleaned condition of the street whether the Engineer approves the surface or not.

- C. Tack Coat - A tack coat shall be applied to concrete pavement, chip sealed surfaces, surfaces that are polished and slick or when directed by the Engineer in accordance with CDOT Section 407. Tack coat shall be applied immediately prior to application of the material. Tack shall be applied by an asphalt distributor truck at the rate of 0.10 gallons per square yard. Payment for tack coat shall be made separately at the contract unit price.
- D. Water Fogging - The surface shall be fogged with potable water directly preceding the spreader except where a tack coat was applied.
- E. Application - The slurry mixture shall be of the desired consistency as it leaves the mixer and no additional elements shall be added in the spreader box. A sufficient amount of slurry shall be carried in all parts of the spreader box at all times so that complete coverage is obtained over the application area.

Work hours shall be established at the pre-construction meeting. Each day's application of slurry surfacing shall end with sufficient time to allow for complete curing by the end of the established work hours.

No lumping, balling or unmixed aggregates shall be allowed in the mixer or spreader box. If the coarse aggregate settles to the bottom on the mix, the affected slurry will be removed from the pavement and the problem corrected. No breaking of the emulsion will be allowed in the spreader box. No longitudinal streaks will be allowed in the finished pavement. Any area of longitudinal streaking will be replaced or repaired.

Operators and equipment shall be capable of producing straight lines along curbs and shoulders. No runoff into these areas will be permitted. Overlap onto gutter pans shall not exceed two (2) inches. The Contractor shall remove excessive overlap or runoff. Lines at intersections will be kept straight to provide a neat looking appearance.

1. Joints: Longitudinal joints shall be overlapped no more than 6 inches over previously placed slurry. Building paper shall be used at transverse joints to minimize or eliminate overlap and bumps. No excessive build-up or unsightly appearance shall be permitted on longitudinal or transverse joints. Drags are required and shall be burlap type. Drags must be kept relatively clean and free of excessive build-up. Drags shall be replaced daily or more often at the discretion of the Engineer.
2. Hand Work: Approved squeegees shall be used to spread slurry in areas not accessible to the slurry mixer. Squeegee areas shall be hand finished with a burlap drag prior to breaking of the emulsion. Care shall be taken to leave a pleasing appearance similar to that of the machine spreader surface.
3. Curing: The slurry seal mixture shall be cured and the roadway opened to traffic within 3 hours of placement. Each day's application of slurry surfacing shall end with sufficient time to allow for complete curing by the end of normal work hours as set at the pre-construction meeting.

4. Manholes and Valves: Manholes, water valves and other street appurtenances on streets to be slurry sealed shall be clean during and after the work is completed. They shall be covered in a suitable manner prior to sealing and the covering shall be removed immediately after the street is sealed.
5. Finish: No streaks, such as those caused by oversized aggregate, will be left in the finished surface. No ripples or chatter marks will be allowed. If these conditions develop, the job will be stopped until the Contractor proves to the Engineer that the situation has been corrected. After lay-down work is completed and before final acceptance by the Engineer, spot application of slurry seal material may be required to correct any deficiencies such as streaking, chattering, scuff marks, tire tracks, gaps, etc., to improve the ride quality and overall appearance. Slurry seal repairs will be made at the Contractor's expense.

12.3.2 Chip Seal

- A. Surface Preparation - Surface preparation shall be in accordance with paragraph 12.3.1 B.
- B. Equipment – Equipment shall be in accordance with Section 409 of CDOT Standard Specifications for Road and Bridge Construction.
- C. Application – CRS-2P shall be applied at a rate of 0.35 to 0.38 gallons per square yard. Application of bituminous material and application of cover coat material shall be in accordance with Section 409 of CDOT Standard Specifications for Road and Bridge Construction. Work hours shall be established at the pre-construction meeting. Each day's application of slurry surfacing shall end with sufficient time to allow for complete curing by the end of the established work hours. The Contractor shall be responsible for cleaning all utility covers following application of chip seal.
- D. Sweeping and Fog Seal – Chip sealed surface shall be swept of loose chips one day following application. After sweeping, surface shall be immediately coated with a fog seal at the rate of 0.10 gallons per square yard. Sweeping and fog seal operations are to be accomplished in such a manner as to provide overnight set on fog seal prior to opening for traffic. Work should be conducted after 7:00 PM with opening of traffic prior to 6:00 AM the next day. If fog seal cannot be applied immediately after sweeping, the street shall be swept again before fog seal.

12.3.3 Hot Chip Seal

- A. Equipment - All equipment, tools, and machines used in the performance of this work shall be maintained in satisfactory working order at all times.
 1. Chip Seal Equipment
Chip seal equipment shall be in accordance with Section 409 of CDOT Standard Specifications for Road and Bridge Construction.
 2. Mixing Plant for Hot Cover Coat
The mixing plant shall be capable of producing a uniform material, have adequate capacity, and be maintained in good mechanical condition.

Dust, smoke, or other contaminants shall be controlled at the plant site to meet all air quality requirements in the "Colorado Air Quality Control Act," Title 25, Article 7, CRS and regulations promulgated thereunder.

3. Hauling Equipment for Hot Cover Coat

Trucks used for hauling shall have clean beds thinly coated with a minimum amount of paraffin oil, lime solution, or other approved release agent. Petroleum distillates such as kerosene or fuel oil will not be permitted. Each truck shall have a cover of canvas or other suitable material to protect the mixture from the weather and excessive temperature loss or cooled layers of mix in truck.

4. Bituminous Pavers for Hot Cover Coat

Self-propelled pavers shall be provided for full lane width paving, and shall be equipped with a screed assembly, heated if necessary, capable of spreading and finishing the bituminous plant mix material in full lane widths applicable to the typical section and thickness shown in the Contract.

The paver shall have an automatic distribution system that will place and spread the mixture uniformly in front of the screed.

The paver shall be capable of operating at forward speeds consistent with uniform and continuous laying of the mixture. Stop and go operations of the paver shall be avoided. The screed or strike-off assembly shall produce the specified finished surface without tearing, shoving, or gouging the mixture. Self-propelled pavers shall be equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, and maintaining the screed at the specified longitudinal grade and transverse slope. The sensor shall be constructed to operate from either or both sides of the paver.

The controls shall be capable of maintaining the screed at the specified transverse slope within plus or minus 0.1 percent. Automatic mode should be used where possible. If the automatic controls fail or malfunction the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained.

5. Rollers for Hot Cover Coat

Steel wheel rollers shall be used to seat the hot cover coat material.

B. Application - Chip seal application, to include sweeping and fog seal, shall be in accordance with paragraph 12.3.2 of these Specifications.

Hot cover coat shall be applied within 5 days of the chip seal application. The material shall have a minimum temperature of 275 degrees F at placement and be applied in a ½" thick layer. A minimum of two steel wheel rollers making two or more passes shall follow immediately to seat and cool the material. The Contractor shall be responsible for cleaning all utility covers following application of hot cover coat.

Crack SealA. Surface Preparation

Two weeks prior to filling of cracks, a weed killer shall be applied to all cracks containing weeds. Such weed killer shall be approved by the City prior to application. No separate payment will be made, but shall be included in the other items of work. Cracks to be filled shall be dry and cleaned of loose and foreign matter to a depth of approximately twice the crack width immediately prior to sealant application. Cleaning and drying shall be accomplished using a hot compressed air lance. **The air lance shall be equipped with a bonnet or shield to minimize the amount of flying debris** and shall be directed toward the street, away from private properties. The Contractor shall sweep and clean blown material off sidewalks on the same day that cracks are cleaned and dried. The City shall coordinate and perform street sweeping after crack sealant operations are complete.

B. Sealant

Sealant material shall be supplied pre-blended, pre-reacted, and pre-packaged. If supplied in solid form, the sealant material shall be cast in a plastic or other dissolvable liner having the capability of becoming part of the crack sealant. Sealant shall be delivered in the manufacturer's original sealed container. Each container shall be legibly marked with the manufacturer's name, the trade name of the sealer, the manufacturer's batch or lot number, the application temperature range, the recommended application temperature and the safe heating temperature. Only pre-tested material with identification number corresponding to certified test results will be accepted for the job. Using material that is a mixture of different manufacturer's brands or different types of sealant is prohibited.

Crack seal material to be used on the project shall be stored and adequately covered at the storage site specified in the contract Special Conditions. Delivery tickets shall be given to the Project Engineer and shall be used to account for material at the beginning and end of the project and as a basis for monthly pay estimates. Material usage will be monitored daily as a means of indicating yield.

C. Application

All cracks with widths larger than 1/8 inch and less than one (1) inch, including joints at concrete gutter lip where practical, shall be filled with hot poured crack sealant flush with the pavement surface. Immediately following the filling, any excess sealant shall be leveled off at the surface by squeegee, a shoe attached to the applicator wand or other suitable means approved by the engineer. The squeegeed material shall be centered on the cracks and shall not exceed three (3) inches in width and 1/16 inch in depth. Material applications exceeding these limits will be subject to quantity deduction.

Sealant shall be applied only when pavement and air temperature are at least 40 degrees F and rising and crack faces shall be surface dry.

Contractor shall not crack sealing areas of alligator or block type cracking. A deduction will be made, as determined by the Project Engineer, for crack sealant in those types of cracked areas.

Sealant material shall be heated according to the manufacturer's recommendations and shall be applied at the manufacturer's recommended temperature. Equipment used for heating the material shall be constructed as an indirect heating type double

boiler using oil or other heat transfer medium and shall be capable of constant agitation. Additionally, the heating equipment shall be capable of controlling the sealant material temperature within the manufacturer's recommended temperature range and shall be equipped with a calibrated thermometer capable of +5 degrees F accuracy in the range of 200 degrees F to 600 degrees F. The thermometer shall be located in such position to allow the engineer to safely check the sealant temperature at his discretion. Overheating the material instantaneously or holding it at elevated application temperatures for periods of time in excess of that recommended by the manufacturer will be cause for rejection at the Contractor's expense. Heating equipment shall be emptied at the end of each day's operations.

Sealant material picked up or pulled out after being placed shall be replaced at the Contractor's sole expense. Tracking and or pulling out of material shall be cause for its rejection for use on the project. The Contractor shall have blotter material available on the project at all times in the event it is required to prevent tracking or pulling. Blotter material shall be subject to prior City approval and no separate payment will be made for furnishing and/or placing it. Any property damage resulting from surface preparation, application, tracking or pullout shall be corrected at the Contractor's expense.

12.3.5 Storage Site

If required, the Contractor is responsible for finding a storage site for equipment and stockpiled materials unless a location is specified in the contract Special Conditions.

12.3.6 Weather Limitations

No emulsion seal coats shall be applied:

- A. When there is any danger the finished product will freeze before it cures completely.
- B. When the pavement or air temperature is 70 degrees or below and falling.
- C. In the period following a rain while puddles of water remain on the surface to be coated.
- D. During periods of abnormally high humidity or when rain may fall within four hours of placement.

12.3.7 Traffic and Parking Control

Traffic control and "NO PARKING" signs shall be required in accordance with the contract Special Conditions. Residential streets may be closed to traffic during resurfacing operations. Closures shall be coordinated so that parking for residents is available within one street of a closed street. Collector streets, as designated in the contract documents, must remain open in one direction during resurfacing operations.

12.3.8 Storm Damage

Areas damaged by storm related events will be re-surfaced as directed by the Engineer. Costs associated with repairing storm damaged areas and removal of asphalt emulsion from curbs, ditches and lawns will be the responsibility of the Contractor. The Contractor will be allowed to suspend work to minimize the potential for storm damage to the surfacing and surrounding facilities with an appropriate adjustment to contract time.

12.3.9 Citizen Notification

The Contractor shall notify all properties adjacent to construction with a door hanger a minimum of 24 hours prior to commencement of work. The City will provide door hangers. In the event there is a delay due to weather, equipment or other causes, the Contractor shall give a minimum of 24 hours notice with another door hanger. Contractor shall provide a 24-hour phone number that will be printed on the door hanger for calls from citizens.

WORK WILL NOT BE ALLOWED IN AREAS WHERE REQUIRED NOTICES HAVE NOT BEEN GIVEN.

12.3.10 Warranty

The Contractor shall warrant the work under this project for two (2) years following the completion date of the project.

12.3.11 Measurement and Payment

Seal coats and tack coats shall be measured by the square yard of surfaced pavement, complete-in-place, applied in accordance with the contract documents. Payment shall be made in accordance with the square yard unit price for the specified seal coat and tack coat.

Hot poured joint and crack sealant will be measured by the ton of material used. The engineer may require weighing of equipment, weighing of material, kettle depth measurement or take necessary steps to ensure adequate and correct measurements of materials applied. Payment for tons of hot poured joint and crack sealant shall constitute full compensation for furnishing all labor, equipment, materials and incidentals required to clean and dry.