

ITEM 15 CHIP SEAL

15.1 DESCRIPTION

The **CONTRACTOR** shall furnish all labor, equipment, materials, supplies, mobilization and demobilization, and other incidentals necessary to provide a friction course satisfactory to the **AGENCY** at the location and limits specified in the plans. Traffic control shall be provided at no additional cost. All workmanship and materials shall conform to the specifications contained herein.

15.2 MATERIALS

15.2.1 Polymer Modified Asphalt Emulsion

Asphalt emulsion shall conform to the requirements of AASHTO M 140 and M 208 for the designated grades. The asphalt shall be polymer modified before emulsion using either a Styrene - Butadiene or Styrene – Butadiene - Styrene block copolymer and shall contain at least 4 percent polymer by weight. The completed emulsion shall be capable of standing un-agitated for a period of 24 hours and shall not show milky, white separation and shall be smooth enough for pumpability and for application through a distributor. The mixture shall contain polymer modified asphalt, water and emulsifiers and meet the requirements of HFMS-2hP, CMS-2hP, or CRS-2P as shown below in Table 15.2.1.

**TABLE 15.2.1
EMULSIFIED ASPHALT SPECIFICATIONS**

TEST	HFMS-2-HP	CMS-2HP	CRS-2P
Viscosity @ 122° F (AASHTO T 59)	50 to 450	50 to 450	80 to 400
Storage Stability (24 hrs) (AASHTO T 59)	1 % Max.	1 % Max.	1 % Max.
Particle Charge Test (AASHTO T 59)	--	Positive	Positive
Sieve Test (AASHTO T 59)	0.10% Max.	0.10% Max.	0.10% Max.
Oil Distillate by Volume (AASHTO T 59)	3% Max.	3% Max.	3% Max.
Residue by Distillation (AASHTO T 59)	65% Min	65% Min	73% Min.
Solubility in TCE (AASHTO T 44)	97.5% Min. ¹	97.5% Min. ¹	97.5% Min. ¹
Penetration @ 77° F (AASHTO T 49)	70 to 150 ¹	70 to 150 ¹	70 to 150 ¹
Float Test (AASHTO T 50)	1200 Min. ¹	--	--
Coatability (AASHTO T 59)	Good	Good	Good
Demulsibility (MSTHO T 59)	--	--	40 Min.
Toughness, 77° F (CPL 2210)	--	--	Min. 70 in-lb
Tenacity, 77° F (CPL 2210)	--	--	Min. 45 in-lb
Ductility @ 77° F (AASHTO T 51)	75 Min. ¹	75 Min. ¹	75 Min. ¹

¹Denotes tests run on residue from distillation

A 1-quart sample of the final emulsion along with a certificate of compliance shall be submitted to the AGENCY for compliance testing. The source of the base asphalt, polymer, additives, and supplier shall be stated on the sample and shall not change during the course of construction. The AGENCY may reject the asphalt, at its discretion, based upon failing tests or incompatibility with the aggregate. Rejection shall not be cause to delay or increase the cost of the project. The **CONTRACTOR** shall submit samples at least 14 days before construction.

15.2.2 Aggregates

Aggregates shall be hard, durable, clean rock and be free of any coatings or deleterious material. At least 90 percent by weight of the aggregate retained on the No. 4 sieve shall have at least two fractured faces. The aggregate shall have a maximum loss of 20 percent when tested using the LA Abrasion procedure as defined by AASHTO T 96. Only one type of aggregate shall be used and substitutions shall not be allowed. When tested using AASHTO T 182, the aggregate shall retain at least 95 percent of the emulsion. When tested by the boiling water stripping test method ASTM D 3625, the aggregate shall retain at least 80 percent emulsion. The aggregate shall conform to the gradation shown on Table 15.2.2.

**TABLE 15.2.2
AGGREGATE GRADATION**

Sieve Size	% Passing by Weight
1/2 inch	100
3/4 inch	90 to 100
1/4 inch	0 to 50
No. 8	0 to 3
No. 200	0 to 1

The **CONTRACTOR** shall keep aggregates moist, but not wet while in the stockpile by use of light sprinkling. Aggregates shall not be delivered to the job site at moisture contents greater than 2.0 percent by weight. The aggregates shall be from a single pit and shall be the same as samples submitted for testing. Pits or aggregates sources shall not change during the course of construction.

15.3 MIX DESIGN

The **CONTRACTOR** shall submit to the **AGENCY** a mix design performance by an independent laboratory and signed and stamped by an engineer registered in the State of Colorado. The design shall be done using the aggregate and emulsion designated for the work. The **CONTRACTOR** shall also submit a 100-pound sample of the aggregate for testing along with 1 gallon of the emulsion to the **AGENCY**. The **AGENCY** may test the material for gradation, stripping, compatibility and other tests

it deems necessary to validate the mix design. The AGENCY may reject the emulsion or the aggregate at its discretion for incompatibility. Any rejection shall not be cause to delay or increase the cost of the project.

15.4 EQUIPMENT

Equipment required to apply a chip seal shall include at least a one sweeper, one distributor, one aggregate spreader, two pneumatic tired rollers and one steel wheel roller, as well as other incidental equipment necessary to complete construction in a timely and efficient manner. This group of equipment shall be denoted as a unit spread and shall be the minimum equipment allowed. Additional unit spreads shall be allowed, additional distributors, aggregate spreaders etc. shall be allowed as back-up or storage only and shall not be used without the written approval of the **AGENCY**. The size and condition of all equipment shall be approved by the **AGENCY**. Should equipment be unsatisfactory to the **AGENCY** for whatever cause, the **CONTRACTOR** shall remove and replace the equipment without delay or cost to the **AGENCY**. The equipment shall conform to the minimum requirements listed in the following sections.

15.4.1 Sweeper

The sweeper used shall be a rotary power dry sweeper capable of removing excess aggregate and debris including caked mud and other deleterious materials from the project limits show on the plans. In addition, the **CONTRACTOR** may be required to clean the surface of the pavement. The **CONTRACTOR** shall have access to a rotary wet cleaning street sweeper and a high pressure water sprayer for cleaning the pavement surface.

15.4.2 Distributor

The distributor used for this project shall be computer controlled and capable of providing a uniform application rate varying from 0.10 to 1.0 gallon per square yard of emulsion uniformly over a variable width up to 12 feet in a single pass. The uniformity of the distributor shall not vary by more than 0.02 gallons per square yard and testing by the **CONTRACTOR** shall

be required to verify the uniformity. The distributor shall be equipped with a variable power unit for the pump and full circulation spray bars which are adjustable laterally and vertically. The distributor spray bar shall contain nipples and valves so constructed that the nipples will not become partially plugged with congealing asphalt material. The nozzle angle and bar height shall be set to provide 100 percent of double coverage in a single pass. Where multiple passes will be required to complete the full width, the 4 inches adjacent to the second pass may be left with 50 percent coverage so that the next pass completes the full application rate specified. The distributor shall also contain calibrated and working heater, tachometer, pressure gauges, volume measuring devices, and a thermometer to measure the tank temperature. Calibration records and/or independent testing reports shall be required prior to approving the distributor.

15.4.3 Aggregate Spreader

The aggregate spreader shall be computer controlled, self-propelled and shall be capable of applying aggregates at rates of 5 to 50 pounds per square yard in a uniform manner across variable widths up to 12 feet. The variability of the aggregate spreader shall be less than or equal to 1 pound per square yard. Tests shall be run on the aggregate spreader to determine the variability using the specified aggregate gradation for this project. The tests shall be run by the **CONTRACTOR** and witnessed by a representative of the **AGENCY**.

15.4.4 Rollers

The two pneumatic tired rollers shall be similar in nature and identical in loaded stress applied to the friction course. The rollers shall be self propelled and equipped with smooth tread tires. The gross load applied to the friction course shall be 200 to 250 pounds per lineal inch of rolling width. The tire pressures shall be within 5 psi and shall be checked daily by the **CONTRACTOR** and reported to the **AGENCY**. Depending upon the speed of the distributor and aggregate spreader, additional rollers may be required. At no time shall the roller travel faster than 3 miles per hour.

Equipment shall be approved by the **AGENCY**. All equipment and machinery shall be kept in good working order, free of leaks and properly muffled. All taxes, licenses and fees shall have been paid and proper licenses and permits shall be posted as required by law.

15.7 CONSTRUCTION

Traffic control shall be provided at no additional cost and shall be in accordance with the *Manual of Uniform Traffic Control Devices*, latest edition. A traffic control plan shall be submitted to the **AGENCY** at least 10 days before any work is performed. The **AGENCY** will review the plan and may require adjustments to accommodate local conditions. There shall be no additional cost to the **AGENCY** for traffic control.

15.7.1 Limitations

Chip seal shall not be applied when air temperature is below 80° F and is falling, but maybe applied when air temperature is 70° F and rising. No construction shall take place when the pavement surface temperature falls below 70 ° F, or when the pavement is moist, or when in the opinion of the **AGENCY**, the weather is or may become detrimental. Detrimental weather is defined as rain showers, cool temperatures, moist pavement or other factors which could affect the performance of the construction. No construction shall occur during hours of darkness.

15.7.2 Surface Preparation

Sweeping shall not precede the application of emulsion by more than 30 minutes. **The CONTRACTOR** shall be responsible for all measures required to provide a thoroughly clean and dry pavement surface including sweeping and washing. The **CONTRACTOR** shall observed the condition of the pavement prior to bidding to determine the work necessary to provide a clean, dry pavement for construction and shall include the work necessary in his bid. No separate measurement and payment for surface preparation shall be made.

15.7.3 Emulsion Application

The application of the emulsion shall be performed by the distributor in a manner to achieve a uniform, continuous spread of emulsion over the section treated. The temperature of the emulsion at the time of application shall be 160° F i15° F. The quantity of emulsion to be applied shall be determined by the **AGENCY** after final design is preformed using the aggregate supplied for the work. The **AGENCY** may, at its discretion alter the application rate by up to 50 percent at any time during the course of construction If, in the opinion of the **AGENCY**, the porosity of the pavement surface is excessive, the **CONTRACTOR** may be required to apply an initial prime coat of emulsified asphalt at the rate of 0.10 gallons per square yard. The **CONTRACTOR** will be paid at unit rates for the prime coat which shall be the emulsion specified in Item 15.2.1.

Construction paper at least 3 feet wide may be used to prevent overspray and at the beginning and end of each spread. The paper shall be used for longitudinal control at all curb lines and where adjacent lanes will not be provided a chip seal. The construction paper shall be disposed of in an environmentally acceptable manner, such as an approved construction materials landfill. Where multiple passes are required to complete the construction shown on the plans, construction paper is not required for the adjacent lane requiring additional passes. Regardless of the control method selected, clean-up shall be done including sand blasting of any overspray.

Manholes, valve boxes and other features within the construction zone specified on the plans which are not to be treated with the friction course shall be protected. The manner of protection shall be either construction paper or use of loose aggregate applied to the feature prior to the application of emulsion. If construction paper is used, the paper shall be properly weighted to prevent its movement by wind and emulsion. The protection shall be left in place during the emulsion and aggregate applications and shall be removed prior to rolling. The excess material shall be disposed of in an environmentally acceptable, manner, such as an approved construction materials landfill.

At the beginning and end of each spread, the distributor shall be moving at the proper speed and be over the construction paper at the time the spray bar is opened or closed. If at any time a nozzle becomes clogged or not spraying a proper pattern, the operation shall be immediately halted until repairs are made. Hand applicators shall be used to correct deficiencies prior to the application of aggregate. At no time shall water or solvents of any kind be used. The emulsion application shall be no more than 30 feet ahead the aggregate spreader. The width of the spread shall be no greater than the width shown on the plans or the width of the aggregate spreader whichever is less, except where additional passes are required the emulsion may be extended four 4 inches beyond the aggregate spread at a 50 percent application rate. At no time shall the emulsion be allowed to break, chill, setup, harden or otherwise impair the aggregate retention. After completion of the spread or during repairs or normal work stoppages, the distributor shall be parked off the roadway and the spray bar shall be protected from spillage on public or private property by use of construction paper.

15.7.4 Aggregate Application

The aggregate shall be applied immediately following the emulsion application, by the approved aggregate spreader at the design application rate. The aggregate spreader shall be calibrated by the **CONTRACTOR** to achieve the design application rate beginning at the start of work in an area not covered by emulsion and the results shall be transmitted to the **AGENCY** within 4 hours of the completion of each test.

The spreader shall be positioned such that the tires of the unit never contact the emulsion. The spreader shall be positioned such that the emulsion does not have time to break, cure, chill, or harden before the aggregate is placed. The width of the aggregate spread shall be equal to the width of the emulsion spread, except where additional passes are required for an adjacent lane. The aggregate spreader shall not cover the outside 4 inches of emulsion which has been applied at a 50 percent application. The **AGENCY**, as its discretion may alter the application rate of the aggregate at any time during the construction operations.

15.7.5 Clean-Up Operation

Areas which are deficient in aggregate or emulsion shall be covered with additional material by the clean-up crew in a manner approved by the **AGENCY** immediately. Aggregate shall not be applied after rolling has commenced, except as directed by the **AGENCY**. The clean-up crew shall have available a pickup, aggregates, crusher fines, hot emulsion and a means of applying emulsion, aggregates and fines to areas which require repair. The clean-up crew shall be responsible for:

- A. Placement and pickup of protection material for manholes, valve boxes, etc.,
- B. Application of additional emulsion, aggregate, or fines necessary;
- C. Clean-up of excess emulsion, aggregates or other materials;
- D. General job site cleanliness; and
- E. Other duties necessary to maintain operations.

15.7.6 Rolling

Initial rolling shall be immediately after the aggregate spreader. A minimum of two pneumatic tired rollers shall be used. A minimum of four complete passes of the roller shall be required. Rollers shall work in tandem and shall overlap 50 percent. Initial rolling shall be completed within 20 minutes after the application of the aggregate and before the emulsion breaks, cures, chills or hardens. Should the rolling operation be delayed, the aggregate and emulsion spreading shall be halted until the operation regain proper sequencing and timing. The maximum speed of the roiling operation shall be 3 miles per hour. A minimum of three passes of the roller shall be required.

15.7.7 Finishing

The adjacent surfaces shall be swept to clear excess aggregates from the job site. It shall be the **CONTRACTOR**'s responsibility to maintain the work during the construction operations and a 4day curing period. All repairs necessary shall be performed by the **CONTRACTOR** at no cost to the **AGENCY**.

A light brooming shall be performed 3 to 4 hours after construction. After 4 hours of curing, the surface shall be rolled again with an additional six passes of the pneumatic tired rollers as described in Item 15.6.4. Excess aggregate shall then be broomed from the roadway and adjacent areas and disposed of in a manner approved by the **AGENCY** at no additional cost to the **AGENCY**. The additional work required to repair deficient areas could include spreading additional aggregate in areas with excess emulsion, additional emulsion and aggregate in areas of deficient coverage, clean-up of areas soiled by the construction, or other repairs necessary to provide a complete and satisfactory product.

After four days, the surface shall be broomed to remove excess aggregate.

15.8 QUALITY CONTROL

The **AGENCY** will be responsible for Quality Control and shall be the sole **AGENCY** for determining the quality of materials and the acceptability of the work. The **AGENCY** may take samples of the aggregate and/or the emulsion at any time and the **CONTRACTOR** shall assist in obtaining these samples. Should the testing indicate any variance from these specifications, the **CONTRACTOR** shall stop work until testing indicates the emulsion or aggregate is within the specifications. Should the **CONTRACTOR** fail to meet these specifications, the **AGENCY** shall not be liable for any payment to the **CONTRACTOR** for the portion of work deemed unsatisfactory due to workmanship or material testing deficiencies.

15.9 MEASUREMENT

The quantities presented on the plans and listed in these specifications are presented for bidding purposes only. Actual material quantities will be determined by the **AGENCY** and will depend upon the design provided by the **AGENCY**. The limits of construction shown on the plans will govern final quantities. For bidding purposes, the **CONTRACTOR** shall assume the following:

TABLE 15.9

Asphalt Emulsion	0.33 gallons per square yard
Aggregate	24.0 pounds per square yard

The **CONTRACTOR** shall provide a single price for add or deduct of both aggregate and emulsion quantities. Application rates of both emulsion and aggregate may be changed in the field at the discretion of the **AGENCY**. The **CONTRACTOR** shall comply with any change in quantities immediately and at no additional cost or delay to the project except for the material quantities. Prices shall include all labor, equipment, materials and incidentals required to complete the project.

15.10 PAYMENT

The **CONTRACTOR** shall be paid for emulsion and aggregate at the plan quantity. Quantities above or below Table 15.9 shall be paid for by the ton for the items listed herein. No additional payments shall be made for items not listed herein and those items necessary to complete the work shall be deemed incidental and shall be included in the bid items listed. Traffic control shall be provided and included within the amount and cost of this Item.

<u>Item</u>	<u>Description</u>	<u>Payment</u>
15.1	Chip Seal	\$/yd ²
15.2	Add/Deduct Asphalt Emulsion	\$/ton
15.3	Add/Deduct Aggregate	\$/ton