May 21, 2008

HIGH PERFORMANCE CHIP SEAL

411 High Performance Chip Seal

411.1 Description

High Performance Chip Seal is a high macro-texture surface treatment that is applied in a continuous operation. High Performance Chip Seal is suitable for all roadways that would receive a conventional aggregate seal and is particularly suited for high-speed, high-traffic applications and is designed for fast return to traffic. The application process consists of the application of a polymer modified asphalt emulsion, (High Performance Chip Seal emulsion), followed immediately with the application of a single layer of aggregate meeting the prescribed aggregate specification.

411.2 Materials

411.2.1 High Performance Chip Seal Emulsion

The base asphalt for the High Performance Chip Seal emulsion shall be modified with the polymer prior to emulsification. The emulsion shall conform to the requirements given in Table 1 and be produced by a supplier listed on Qualified Product Listing 38. The emulsion used in the Sweep Test must be the same emulsion that will be used on the job. Use elastomer polymer consisting of styrene-butadiene (SB), styrene-butadiene-styrene (SBS), or styrene-butadiene-rubber (SBR). The polymer emulsion must be blended into a homogenous, and storage stable product at the asphalt manufacturer's site prior to being loaded into the transport vehicle.

Table 1. High Performance Chip Seal Emulsion (HPCS)

Tests on Emulsion	**Method**	**Min**	**Max**
Sieve test, %	AASHTO T-59	-----	0.5
Viscosity, Saybolt Furol @ 122 ºF, sec.	AASHTO T-59	25	600
Residue from Distillation @ 400 °F, %	AASHTO T-59	65.0	-----
Oil distillate by volume of emulsion, %	AASHTO T-59	-----	2
Tests on Emulsion Residue			
Penetration @ 77 ºF	AASHTO T-49	60	120
Elastic Recovery, @ 50 °F, %	AASHTO T-301	60.0	-----

Table 2. High Performance Chip Seal Compatibility/Performance Test

System Compatibility/Performance Test	**Method**	**Min**	**Max**
Sweep Test, conditioned 1 hour at 35ºC, % Loss	ASTM D 7000	-----	15

411.2.2 Aggregate

Aggregates for High Performance Chip Seal shall be mechanically crushed, shall have at least 90% two or more fractured faces, based on count, of the material retained on the No. 4 sieve as determined by AASHTO TP61, shall come from a supplier listed on Qualified Product Listing 2, and shall conform to the requirements given in Table 3. Do not use slag or marine limestone in High Performance Chip Seal. The aggregate used in the Sweep Test must be the same aggregate that will be used on the job.

The aggregate tested for gradation shall be sampled in accordance with SC-T-1.

Table 3. Aggregate Properties

AGGREGATE SIZE, COMPOSITION BY WEIGHT (AASHTO T11)		
Parameter	Job Site Stockpile	
Sieve Size	% Passing	
1/2 Inch	98.0 Min.	100.0 Max.
3/8 Inch	80.0 Min.	100.0 Max.
No. 4	-----	29.0 Max
No. 200	-----	1.5 Max.

Parameter	Test Method	Minimum	Maximum
Absorption	AASHTO T-84/85	-----	2%
LA Abrasion (C)	AASHTO T 96	-----	42*
Micro-Deval	AASHTO T 327	-----	15*
Flat and Elongated (5:1 Ratio)	SC-T-77	-----	10%

*Use crushed coarse aggregate having an abrasion loss of not more than 52.0% when tested in accordance to AASHTO T 96 (C Grading). If the aggregate's abrasion loss is greater than 42.0%, but less than or equal to 52.0%, test the Micro-Deval abrasion value of the material in accordance with AASHTO T 327 and ensure it does not exceed a maximum of 15.0% loss.

411.3 Equipment

All equipment shall be in good operating condition and conform to the requirements below.

411.3.1 High Performance Chip Seal Application Vehicle

The High Performance Chip Seal Application Vehicle shall be capable of applying a uniform application of High Performance Chip Seal emulsion and cover aggregate without the vehicle driving on the newly applied surface. The application vehicle shall have integrated dual spray bar and aggregate spread hopper whose width can be varied independently during operation. The application vehicle and support trucks shall be capable of continuously applying High Performance Chip Seal emulsion and aggregate. The application vehicle shall be capable of applying the aggregate so that no more than a length of 48 inches of emulsion application is on the road surface without cover aggregate. All systems for the application of materials shall be computer controlled.

411.3.2 Spread Hopper

The spread hopper shall consist of a variable width hopper system including driven augers and spread rolls. The hopper width shall be synchronized with the spray bar width, with a width continuously variable in 4 inch increments at application widths greater than 10 feet and variable in 12 inch increments at application widths less than 10 ft. There shall be continuous conveyor feed to the hopper system. A suitable full-width screen with 1" mesh to reject all oversized materials and foreign objects shall cover the spread hopper. The aggregate spreader will be calibrated in accordance with ASTM D5624. The allowable deviation in the amount of aggregate spread in both transverse and longitudinal directions shall be ±1.0 lbs./yd.^{2}.

411.3.3 Control Systems

The Application Rate Computer shall be able to vary either aggregate or emulsion application rates continuously during vehicle operation. The aggregate computer shall monitor the speed of the High Performance Chip Seal Application Vehicle, and vary the gate opening in order to maintain the set application rate, in lbs./yd.^{2} at forward operating speeds. The emulsion and aggregate computers shall vary the output of emulsion pumps and or aggregate application to maintain the desired High Performance Chip Seal application rate at forward operating speeds regardless of changes in application width. The emulsion computer shall also indicate gallons of binder sprayed, length of roadway surfaced, and area of roadway surfaced. The equipment shall be calibrated at the start of each project.

411.3.4 High Performance Chip Seal Emulsion Application System

An insulated High Performance Chip Seal emulsion tank shall be provided on the High Performance Chip Seal Application Vehicle. The tank shall have a functional capacity gage. The operator's station shall have an indicator of the tank emulsion level. The vehicle shall be capable of transferring additional High Performance Chip Seal emulsion into the tank during continuous operation.

A removable strainer shall be supplied to remove the potential for unwanted material from entering the High Performance Chip Seal emulsion tank.

The spray bars shall allow for positive circulation from one end of the bar to the other. Nozzles shall be spaced on no greater than 4 inch centers on the spray bars and have an individual valve for each spray nozzle, so the spray width can be adjusted synchronously with the aggregate hopper width during operation. The spray bar operating width shall be synchronized with the aggregate hopper width, with a width continuously variable in not greater than 4 inch increments at application widths greater than 10 feet and variable in 12 inch increments at application widths less than 10 ft.

411.3.5 Support vehicles

There shall be support vehicles to allow for continuous feeding and operation of the High Performance Chip Seal Application Vehicle. The support vehicles shall be capable of simultaneously feeding both aggregate and High Performance Chip Seal emulsion to the High Performance Chip Seal Application Vehicle. Further, the support vehicles shall be capable of supplying the High Performance Chip Seal Application Vehicle as it moves forward during construction.

411.3.6 Rollers

The rollers shall be self-propelled and equipped with smooth pneumatic tires. Under working conditions, the rollers shall have a minimum effective rolling width of approximately 5.7 ft. The minimum total weight for each of the rollers shall be 12.0 tons. The rollers shall be equipped with tires that will afford ground contact pressures of a minimum of 80 psi. The operating load and tire pressure shall be within the range of the manufacturer's charts showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished. Under working conditions, all tires shall be within plus or minus 5 psi of each other. The power unit shall move the operating rollers at variable uniform speeds up to a maximum of 5 miles per hour. The rollers shall be equipped with automatic tire cleaning scrapers to remove any aggregate that may adhere to the roller tires during operation. The cleaning system shall be operational during construction.

411.3.7 Aggregate removal equipment

Rotary brooms of various types are normally appropriate for excess aggregate removal. All rotary brooms shall have the following capabilities and shall be in good repair in order to apply controlled uniform sweeping pressure across the width of the broom. Equipment tires shall have road tread; no tractor tires are permitted. The equipment shall have variable down pressure, variable angle of approach, and independently controllable variable rotational speed. The broom bristles shall be straight, a minimum of 5 inches in length, and uniform length across the width of the broom. The vertical motion of the broom shall keep the axis of the broom parallel to the road surface at all times; the entire width of the broom shall contact the pavement essentially simultaneously as the broom contacts the road surface.

Regenerative vacuums, pick-up brooms, and other types may be used as well.

411.3.8 Pilot vehicle

If traffic control cannot keep local traffic off the new surface until final sweeping, a pilot vehicle shall be used unless otherwise directed by the RCE.

411.3.9 Water truck

The water truck, if required, shall be suitably equipped to allow spraying of the aggregate stockpile to maintain proper aggregate moisture.

411.4 Stockpiling and Storage

411.4.1 Aggregate Storage

If the mineral aggregates are stored or stockpiled, handle in such a manner as to prevent segregating, mixing of the various materials or sizes, and contaminating with foreign materials. Ensure that the grading of aggregates proposed for use and as supplied to the project is uniform. Utilize suitable equipment of acceptable size to maintain the stockpiles and prevent segregation of aggregates. Temporary stockpiling of aggregates on the right of way may be permitted, provided that the stockpiles are so placed as to allow for the safety of the traveling public and not obstruct traffic or sight distance, and do not interfere with access from abutting property, nor with roadway drainage. The stockpile site must provide a suitable base for the aggregate to maintain cleanliness and avoid contamination. The aggregate placement sites will be subject to the approval of the RCE. The Contractor shall load, haul, distribute and apply the stockpiled aggregate in accordance with specification requirements governing this item. The stockpile areas and remaining stockpiles shall be left in a condition satisfactory to the RCE. The aggregate surface should be visibly moist for proper application. If necessary, the stockpile shall be sprayed with water to maintain aggregate moisture. If water is draining from the aggregate trucks, the moisture is excessive.

411.4.2 Storage of Asphalt Material

All equipment used in storing or handling High Performance Chip Seal emulsion shall be kept clean and in good operating condition at all times and shall be operated in such a manner that there will be no contamination of the High Performance Chip Seal emulsion. The High Performance Chip Seal emulsion shall be transferred directly to the support vehicles or application equipment from the transport tankers; no other storage tanks shall be used. Material not used within 48 hours of initial delivery should be returned to the producing facility. The contractor shall provide and maintain a temperature-measuring device to indicate the temperature of the High Performance Chip Seal emulsion in the transport tankers. The temperature of the High Performance Chip Seal emulsion shall be maintained at a minimum of 140 °F in the transport tankers. No High Performance Chip Seal emulsion shall be stored in the application vehicle overnight.

411.5 General

411.5.1 Weather Limitations

In general High Performance Chip Seal should be applied during the portion of the year in which weather conditions are typically warm and dry. High Performance Chip Seal may be applied when the air temperature is above 60 °F and stable. The air temperature is taken in the shade and away from artificial heat (measured in accordance with SC-T-84). High Performance Chip Seal shall not be applied when the temperature of the surface on which the surface treatment is to be applied is below 60 °F. Application of High Performance Chip Seal shall be stopped at least 2 hours prior to expected rain and 48 hours prior to freezing conditions. No surface treatment work shall be performed between October 15 and March 15 inclusive except with the written permission of the RCE.

411.5.2 Surface Preparation

The area to be treated shall be cleaned of dirt, dust or other deleterious matter by sweeping or other approved methods prior to High Performance Chip Seal application to ensure a clean surface at time of application.

411.5.3 Test Section

New or unproven systems shall be pre-qualified at no additional cost to the department in a test section to demonstrate adequate compliance with this specification prior to any project work. The work shall demonstrate that the system is capable of meeting the requirements of Subsections 411.3 of this specification. The materials used in the pre-qualification shall be those which will be used in the actual project. The RCE shall locate the test section, which shall be one lane, 12 feet in width and not to exceed 1/4 mile in length or an equivalent area. If the application to the test section is unsuccessful, the Contractor shall make the necessary corrections and apply a new test section.

At the discretion of the RCE, adequate documentation of successful experience with the system from other agencies may be used in lieu of constructing a test section. Such documentation should include job description, environmental conditions, and appropriate verification that the system met the required specification and performance.

411.6 Construction

411.6.1 Material Application

A laboratory must be AASHTO accredited in the applicable tests and acceptable to the AME for the High Performance Chip Seal treatment design, including typical target rates* (see table below) of both High Performance Chip Seal emulsion and aggregate, shall provide the design information to the contractor prior to the start of the project

	Quantities Per Square Yard
Apply HPCS Emulsion (gal.)	0.30-0.60 (0.40 typical target)*
Immediately spread using aggregate (lbs.)	15-25 (18 typical target)*

The typical target rates shown on the plans for High Performance Chip Seal emulsion and aggregate are for estimating purposes only. The rates may be varied as directed by the RCE, based on the existing pavement surface conditions and the recommendation of the High Performance Chip Seal emulsion supplier. The target spread rate must be controlled within plus or minus 2 pounds per square yard based on the weight of dry aggregate. Apply a 5 percent reduction in unit price for each pound of aggregate per square yard less than the target spread rate tolerances established above for each day's placement of material. The entire width of each application of High Performance Chip Seal emulsion shall be covered immediately with aggregate, as per Subsection 411.3.1.

Prior to starting the application, sufficient materials shall be available for continuous application. No free water should be evident on the aggregate or in the supply vehicles.

Feed vehicles shall transfer aggregate to the application vehicle without spillage to prevent the presence of loose aggregate on the road surface prior to emulsion application.

Paper or other suitable material shall be used to prevent overlapping of transverse joints. Longitudinal joints shall match lane lines unless otherwise approved by the RCE.

411.6.2 Rolling

There shall be a minimum of 3 rollers available for construction; more may be required depending on the planned application width, speed, and rolling pattern. The entire surface shall be rolled a minimum of one time prior to the sweeping operation.

411.6.3 Excess Aggregate Removal

The High Performance Chip Seal system shall be capable of sweeping without damage within one hour after application per the weather limitations in Subsection 411.5.1. Surplus aggregate shall be removed from the finished surface by brooming after all rolling is completed. Particular attention should be given to all construction seams to fully remove excess material from these locations. There shall be a minimum of 4 rotary brooms available for construction to sweep all areas of the surface a minimum of 3 times and keep up with the application vehicle so that a continuous High Performance Chip Seal process can be maintained.

The application area shall not be released to normal traffic until excess aggregate has been removed from the road surface to the satisfaction of the RCE.

411.6.4 Traffic Control

The High Performance Chip Seal shall be ready for release to normal traffic within 2 hours of material application. Maintain traffic control as necessary to prevent damage to the mixture. Repairs to any such damage done by traffic to the mixture will be at the Contractor's expense.

411.7 Quality Control

411.7.1 QC Sampling

The following measures shall be used by the Contractor to maintain quality control and uniformity. The SCDOT will be responsible for obtaining all the quality control reports from the contractor in accordance to the table below.

Test Material	Sampling / Test Method	Test Frequency (minimum)
Aggregate	SC-T-1 / AASHTO T-11	Every 500 tons
Emulsion	SC-T-61 / AASHTO T 59	Every 25,000 gallons

Initial test results for the products above must be made available to the RCE prior to production of any mixture. If any of the QC test results fail to meet specifications, placement of the high performance chip seal shall not start or must stop until all materials meet requirements. All other test results must be submitted to the SCDOT within 3 working days, after initial tests are submitted. The contractor shall identify the cause of the discrepancy and document in detail what corrective action was taken to resolve issue. Documentation of the corrective action shall be furnished to and accepted by the RCE before placement can continue. Corrective action may include removal of all or portions of the failing material. Quality Assurance samples must be taken randomly by the SCDOT as documented in the latest Construction Manual.

411.7.2 QC Equipment

The Contractor will be responsible for the equipment operation and calibration. The High Performance Chip Seal emulsion shall be sprayed by a metered mechanical pressure spray bar. This device shall accurately and continuously monitor the rate of spray and provide a uniform application across the entire width to be overlaid. Adjustments to the spray rate based upon the existing pavement surface conditions may be required.

The application equipment shall be capable of measuring and recording the total emulsion applied with an accuracy of +/- 5%. A daily log should be maintained recording the total area covered and the total volume of emulsion applied. This data should be compared to the calibrated application rates daily.

411.8 Acceptance

The Contractor shall be responsible for the maintenance of the surface treatment until the work is accepted by the RCE. Damage or loss of aggregate in the surface exceeding 2% of the surface area in any 500 ft. linear section shall be repaired by use of additional asphalt and aggregate. All bleeding (excess asphalt) surfaces shall be covered with approved cover material in such a manner that the asphalt material will not adhere to or be picked up by the wheels of vehicles.

If in the RCE's judgment, defective areas warrant removal, the Contractor shall remove and replace those areas at the Contractor's expense with materials meeting specification requirements.

411.9 Measurement

The High Performance Chip Seal shall be measured by the square yards of pavement surfaced and gallons of emulsion applied in accordance with the specification.

411.10 Payment

The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit bid prices. High Performance Chip Seal will be paid on the contract unit price for full compensation for furnishing all materials, including polymer modified asphalt materials, and for the equipment, work, labor, and traffic control.

Payment will be made under:

Item No.	Item	Pay Unit
4100100	High Performance Chip Seal Application (including aggregate)	SY
4100105	Emulsion for High Performance Chip Seal	GAL
6319505	Removal of Existing Thermoplastic	LF