617-T-213 HIGH FRICTION SURFACE TREATMENT

(Revised 06-19-25)

The Standard Specifications are revised as follows:

SECTION 617, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

SECTION 617 – ~~BLANK~~*HIGH FRICTION SURFACE TREATMENT*

617.01 Description

This work shall consist of applying a high friction surface treatment, HFST, on asphalt or concrete pavement to enhance the skid resistance.

The HFST shall be composed of calcined bauxite aggregate bound with a polymeric resin.

617.02 Materials

Materials shall be in accordance with the following:

(a) General

A Type A certification in accordance with 916 and test reports from an independent laboratory shall be provided for polymeric resin binder and aggregate at least 14 days prior to application. The results of the following, listed in (b) and (c), shall be shown on the certification.

Materials shall be stored in a clean, dry environment and in accordance with the manufacturer's recommendations.

Material safety data sheets, product data sheets, and other information pertaining to the safe practices for the storage, handling, and disposal of the materials, and their health hazards shall be obtained from the manufacturer and posted at the material storage areas. A copy of such information shall be provided to the Engineer.

(b) Polymeric Resin Binder

The polymeric resin binder shall consist of a two part thermosetting polymer resin compound which holds the aggregate firmly in position, and in accordance with the following:

POLYMERIC RESIN BINDER MATERIAL PROPERTIES REQUIREMENTS		
Property	*Test Method*	*Requirements*
Adhesion Strength, psi @ 24 hrs	*ASTM C1583*	*250 minimum or 100% substrate failure*
Compressive Strength, psi, minimum	*ASTM C579, Method B*	*1,000 (3 hours)* *5,000 (7 days)*
Cure Rate (Dry through time), hours	*ASTM D1640,* *55 mil wet thickness @ 75°F*	*3 maximum*
Durometer Hardness (Type D)	*ASTM D2240, Type 1* *precision Type D method*	*60 – 75* *(7 days, 73˚F)*
Elongation at Break Point, %	*ASTM D638, Type I specimens*	*40 – 80*

		(7 days, 73˚F)
Gel Time for concrete surfaces, minutes	*ASTM C881 AASHTO M 235*	*10 minimum*
Mixing Ratio	*Provide manufacturer's recommendations a minimum of 14 days prior to application*	*Per manufacturer*
Modulus @ 73°F, psi	*ASTM C881 (7 days)*	*≤ 100,000 (asphalt) ≤ 130,000 (concrete)*
Ultimate Tensile Strength, psi	*ASTM D638, Type I specimens*	*1,500 - 5,000 (7 days)*
Viscosity, poises @ 10 minutes	*ASTM D2556*	*7 - 30*
Water Absorption, %	*ASTM D570*	*1 maximum*

The binder test specimens shall be cured for seven days at 73 ±2°F and tested immediately upon curing.

(c) Aggregate

The aggregate shall be calcined bauxite that is clean, dry, free from foreign matter, and in accordance with the following:

CALCINED BAUXITE AGGREGATE MATERIAL REQUIREMENTS		
Property	*Test Method*	*Requirements*
Aluminum Oxide, %	*ASTM C25*	*87 minimum*
Gradation *Sieve Designation:* *No. 4 (4.75 mm)* *No. 6 (3.35 mm)* *No. 16 (1.18 mm)* *No. 30 (600 µm)*	*AASHTO T 27*	 *Percent Passing:* *100* *95.0-100.0* *0.0-5.0* *0.0-1.0*
LA Abrasion Loss, % (C Grading)	*AASHTO T 96*	*12.5 maximum*
Micro-Deval Abrasion Loss, % (NMAS-9.5 mm)	*AASHTO T 96*	*5.5*
Moisture Content, %	*AASHTO T 255*	*0.2 maximum*
Minimum Polish Value, PV-10 (NAS-9.5 mm, main scale)	*AASHTO T 279*	*59*

(d) Quality Control Plan

The Contractor shall submit a Quality Control Plan, QCP, to the Engineer for approval at least 14 days prior to application. The QCP shall show proposed methods to control the equipment, materials, mixing, and paving operations to ensure conformance with these specifications. The QCP shall contain, at a minimum, the following information:

1. *Key personnel with contact information.*

2. *Polymeric resin production plants, location of plants, personnel qualifications, inspection and record keeping methods, equipment calibration records, and accreditation certificates.*

3. *Aggregate production plant locations, personnel qualifications, inspection and record keeping methods, equipment calibration records, and accreditation certificates.*

4. *Mix design in accordance with the manufacturer's recommendations.*

5. *Moisture control methods of aggregate.*

6 *List of manufacturer recommendations for storage of material, weather restrictions, working and set-up time, curing time, and opening to traffic.*

7. *Cleaning and maintenance schedule for truck-mounted application machine, including metering and monitoring devices.*

8. *Corrective actions that shall be taken for unsatisfactory construction practices and deviations from specifications.*

9. *A technical expert from the polymeric resin manufacturer shall be on call or on site for the startup operations to advise construction personnel in placing the HFST.*

10. *The QCP shall designate a QC Manager. The QC Manager shall be on the jobsite at all times during placement of the HFST.*

The QC Manager shall be responsible for the required field quality control sampling and testing in conformance with the approved quality control plan and contract documents. All sampling shall be performed in the presence of and in locations as directed by the Engineer. The Contractor shall maintain and make available upon request complete records of sampling, testing, actions taken to correct problems, and quality control inspection results.

CONSTRUCTION REQUIREMENTS

617.03 Truck-Mounted Application Machine

The HFST application machine shall be capable of the uniform application of the binder and aggregate at a minimum continuous application rate of 2,300 sq yd/h.

617.04 Weather Restrictions

The polymeric resin binder material shall be applied on dry surfaces, between May 1 and September 30, when the ambient temperature is at least 65°F and rising, but no more than 100°F.

The HFST materials shall not be placed when rain is forecast during application or curing. There shall be no visible moisture present on the surface of the pavement at the time of application of the HFST. A plastic sheet, 18 in. by 18 in. that is left taped in place for a minimum of two hours, in accordance with ASTM D4263, shall be used to identify moisture in the pavement.

617.05 Preparation

Roadway patching shall be performed in accordance with 304.04 for asphalt pavement and 506 or 901.07 for PCCP.

All inadequately sealed joints and cracks 1/4 to 1/2 in. wide shall be cleaned and filled in accordance with 408 with a sealant approved by the polymeric resin manufacturer, which will bond to the specified polymeric resin binder. Cracks shall be blown clean using a compressed air lance. The cleaned cracks shall be filled with the approved sealant such that the surface is flush with the pavement. Cracks wider than 1/2 in. shall be patched.

The Contractor shall protect utilities, drainage structures, curbs, and any other structure within or adjacent to the area to be treated. The Contractor shall cover and protect all bridge expansion joint devices, existing pavement markings, preformed joint seal, raised pavement markers, and vehicle detection materials that will remain prior to HFST application.

HFST applied on either new HMA or new PCCP surface or HMA patches, shall be applied at least 30 days after placement of the underlying pavement.

HFST applied on PCCP patches shall be applied at least 30 days after placement of the patch unless rapid setting patch materials are used in accordance with 901.07 and with written approval from the polymeric resin manufacturer. Areas to be patched will be marked on the surface by the Engineer. The marked pavement shall be removed to the depth shown on the typical section, or as directed.

All receiving surfaces shall be clean, dry and free of dust, oil, debris and other material that might interfere with the bond between the polymeric resin binder material and existing surfaces.

Existing PCCP surfaces shall be cleaned by shot blasting to remove all curing compounds, loosely bonded mortar, surface carbonation, and deleterious material. The prepared surface shall comply with the International Concrete Repair Institute, ICRI, standard for surface roughness CSP 5. After shot blasting, air wash, with a minimum of 180 cu ft/min of clean and dry compressed air, to remove all dust, debris, and deleterious material. The Contractor shall maintain the air lance perpendicular to the surface and the tip of the air lance within 12 in. of the surface.

Existing HMA surfaces shall be air washed with a minimum of 180 cu ft/min of clean and dry compressed air to remove all dust, debris, and deleterious material. The Contractor shall maintain the air lance perpendicular to the surface and the tip of the air lance within 12 in. of the surface.

The Contractor shall obtain approval from the Engineer to proceed with installation upon completion of surface preparation.

617.06 Test Section

For quantities greater than 1,000 sq yds, a minimum test section of 200 sq yds shall be applied within the contract to demonstrate the truck-mounted application machine has been properly calibrated. This test section shall be considered part of the HFST quantity on the contract. The Contractor shall correct any deficient areas before opening to traffic as directed by the Engineer at no additional cost. The test section shall be opened to traffic only after curing has completed, and no uncovered polymeric resin remains exposed. The field conditions, including ambient and surface temperatures, anticipated for the production work shall be replicated during the test. The Contractor shall document the settings on the applicator equipment, initial quantities of polymer binder resin and aggregate topping, and unused quantities of resin and aggregate topping remaining in the applicator equipment after applying the HFST. The "dry through time" for the polymer binder resin system shall be noted. The test notes shall be provided to the Engineer.

617.07 HFST Application

(a) Binder Application

The binder components shall be mixed proportionally in accordance with the manufacturer's recommended ratio. The polymeric resin binder shall be applied by a truck-mounted application machine onto the pavement section to be treated. The binder shall be applied at a uniform application rate of 3.5 sq yd/gal. with a uniform thickness of 50 mils onto the pavement. The binder shall not separate in the mixing lines, cure, dry, chill, set up, or otherwise impair retention bonding of the high friction surfacing aggregate. No seams shall be visible in the middle of the traffic lanes of the finished work after application of the surface aggregate.

(b) Aggregate Application

The aggregate shall be applied by the same truck-mounted application machine, which includes an aggregate drop or broadcast spreader, immediately after placing the polymeric resin binder. The Contractor shall not use chip spreaders, vehicle tires, rollers, vibratory compactors or devices that throw loose aggregate onto any part of the live roadway lanes for applying the aggregate onto the wet uncured resin. Recovered bauxite aggregate may only be reused once and shall be blended with new bauxite at a rate of two parts of new bauxite to one part of recovered bauxite. The aggregate shall be applied uniformly to ensure complete coverage of the wet polymeric resin binder and result in a retained rate of 11 to 15 lbs/sq yd. No exposed polymeric resin shall remain visible on the surface.

(c) Polymer Mixing and Distribution Equipment

Polymer mixing and distributing equipment shall, at a minimum, consist of a truck-mounted, temperature-controlled polymer mixing and distribution system capable of accurately blending the resin and hardening components of the polymer system. The mixing and distributing system shall include thermostat heating element-controlled mixing capability. Each component of the polymer shall be in a tote made of a translucent material and shall be supplied by a pump. Wheelbarrows shall not be used as a polymer mixing and distribution system. However, notched squeegees with 3/16 in. deep notches and 1/2 in. nap rollers may be used to distribute the mixed polymer. The amount of the resin and hardener components shall be continuously and independently

measured with flow meters prior to mixing. Mixing shall be in-line and produce a continuous stream of mixed polymer at the manufacturer's required proportioning prior to exiting the dispensing nozzle. The mixing equipment may be either a truck-mounted mechanical mixer or the material may be mixed by a static mixer contained in the wand applicator. The mixing equipment and distribution system shall automatically and accurately proportion the components in accordance with the manufacturer's recommendations, mix, and continuously apply the mixed polymer uniformly and accurately to the work area at the specified rate.

(d) Aggregate Distribution Equipment

The aggregate distribution system shall consist of a truck-mounted air-blown pneumatic spreader using oil-free compressed air in accordance with ASTM D4285. Cleanliness of the compressed air shall be verified by using either an absorbent or non-absorbent white collector material positioned a maximum of 24 in. from the air discharge point, centered in the compressed air stream. The spreader shall apply the aggregate to the surface in a uniform manner. Chip spreaders, salt spreaders, or other rotary-type spreaders shall not be used.

617.08 Curing and Clean-Up

The HFST shall be allowed to cure in accordance with the polymeric resin manufacturer recommendations. Two separate clean-up processes shall be performed by removing the excess aggregate on the treated area and adjacent areas. The Contractor shall perform the initial clean-up before opening to traffic. A secondary clean-up shall be performed three to five days after construction.

617.09 Field Acceptance Testing

The Contractor shall remove and re-apply HFST where any patches of exposed polymeric resin exist, or where the HFST separates from the pavement at no additional cost. The HFST treated area will be tested for Mean Profile Depth, at the discretion of the Engineer, within 90 days after construction in accordance with the requirements in the following tables. Deficient locations shall be repaired or replaced as directed by the Engineer.

FIELD ACCEPTANCE TESTING REQUIREMENTS			
Property	*Requirement, minimum*	*Frequency*	*Test Method*
Friction Number (40 mph)	*80*	*1 per location, or 1 every 1,500 lane-feet, whichever is shorter, between 24 h and 72 h after HFST application*	*ASTM E274 (Smooth tire)*
Mean Profile Depth, mm*	*1.5*	*1 per location, or 1 every 1,500 lane-feet, whichever is shorter*	*ASTM E2157*
** Denotes an optional test.*			

617.10 Method of Measurement

High friction surface treatment will be measured by the square yard, complete in place. The width for measurement will be the width of the top surface as shown on the plans or directed by the Engineer.

Patching will be measured in accordance with 304.06 for asphalt pavement and 506.13 for PCCP.

Pavement marking removal will be measured in accordance with 808.12.

617.11 Basis of Payment

The accepted quantity of the high friction surface treatment will be paid for at the contract unit price per square yard.

Patching will be paid for in accordance with 304.07 for asphalt pavement and 506.14 for PCCP.

Pavement marking removal will be paid for in accordance with 808.13.

Payment will be made under:

Pay Item	***Pay Unit Symbol***
High Friction Surface Treatment	*SYS*

The cost of all materials, equipment, preparation, and testing necessary to apply and clean-up the high friction surface treatment shall be included in the cost of high friction surface treatment.