MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
HIGH FRICTION SURFACE TREATMENT

STM:JD 1 of 5 APPR:SJS:PDS:04-09-21
FHWA:APPR:04-14-21

a. Description. This work consists of cleaning/preparing pavement surfaces and applying a one coat high friction surface treatment (HFST). Ensure preparation of pavement surfaces and application of materials are in accordance with this special provision and the manufacturer's recommendations. Bring any discrepancies between the two to the attention of the Engineer.

b. Materials. Ensure the physical requirements of the properly proportioned and mixed binder meet the requirements in Table 1:

Table 1: Physical Requirements of the Binder

Property	Test Method	Testing Details	Polymeric Resin Requirements	Methyl Methacrylate Resin Requirements
Viscosity	*ASTM D2556*	Use 1 pint sample. Mix 2 to 3 minutes before testing.	Class C: 7 - 30 poises	Class C: 12-20 poises
Gel Time	*AASHTO M235M/M235*	Prepare a 60 gram sample.	Class C: 10 minutes minimum	Class C: 10 minutes minimum
Ultimate Tensile Strength	*AASHTO M235M/M235*	Prepare Type I specimens per *ASTM D638*. Cure for 7 days.	2500 - 5000 psi	1500 - 5000 psi
Elongation at break point	*AASHTO M235M/M235*		30 – 70%	30 – 70%
Durometer Hardness (shore D)	*ASTM D2240*	Cure for 7 days. Use Type 1 stand –Type D Durometer.	60 - 80	40 - 75
Compressive Strength	*ASTM C579*	Prepare specimens per Method "B" (2" cube) using 2.75 parts of sand to one part mixed binder by volume. Sand must meet *ASTM C778*, 20-30 sand. Short duration cure for 3 hours maximum. Long duration cure for 7 days.	1,000 psi minimum at 3 hours 5,000 psi minimum at 7 days	1,000 psi minimum at 3 hours 2000 psi minimum at 7 days
Cure Rate (Dry through time)	*ASTM D1640/D1640M*	Prepare a specimen of 50-55 wet mil thickness. Cure for 3 hours maximum.	3 hours maximum	3 hours maximum
Water Absorption	*AASHTO M235M/M235*		1% maximum	1% maximum
Adhesive Strength at 24 hours	*ASTM C1583/C1583M*	Cure for 24 hours.	250 psi minimum or 100% substrate failure	250 psi minimum or 100% substrate failure

Cure all specimens at 73 degrees Fahrenheit (F) and at 50 degrees F for the noted time. Tolerances for testing and curing temperatures will be ±2 degrees F. Run all resin binder tests at 73 degrees F. Run tests without delay if testing temperature does not match curing temperature.

Provide surface aggregate that is calcined bauxite (minimum of 87 percent aluminum oxide per *Section 15 of ASTM C25*) which is clean, dry, and free from foreign matter. Ensure the aggregate meets the gradation shown in Table 2.

Table 2: Aggregate Gradation

Sieve Size	Minimum % Passing	Maximum % Passing
3/8	100	100
4	98	100
8	30	75
16	0	5
30	0	1
Pan	0	0

Provide general certification per the MDOT's *Materials Quality Assurance Procedures Manual* to the Engineer that the materials meet the requirements specified herein.

c. Construction.

1. Equipment. Provide a distribution system or distributor capable of accurately blending the resin and hardening agent, and uniformly accurately applying the binder materials at the specified rate to the pavement in such a manner as to cover 100 percent of the work area. Provide an aggregate spreader capable of uniformly and accurately applying clean dry aggregate to cover 100 percent of the binder material.

Ensure a system is in place to remove excess debris and aggregate.

For hand applications, provide calibrated containers, a Jiffy® type mixer, and notched squeegees which are suitable for mixing and applying the binder. Use of brooms or straight floor squeegees for binder application is prohibited.

For mechanical applications, provide mixing equipment that will automatically and accurately proportion the components in accordance with the manufacturer's recommendations, mix and continuously place the binder. Ensure the operation proceeds in such a manner that will not allow the mixed material to segregate, dry, be exposed or otherwise harden in such a way as to impair the retention and bonding of broadcasted aggregate.

2. Surface Preparation. Ensure patching and cleaning operations are inspected and approved prior to HFST installation. Protect utilities, drainage structures, curbs, bridge expansion joint devices, pavement expansion and contraction joints, working pavement cracks over 1/4 inch wide, and any other structure within or adjacent to the HFST location from surface preparation activities and application of the surface treatment materials. Protect all existing pavement markings that are adjacent to the HFST location from surface preparation activities and application of the surface treatment materials. Remove no more surface material than will be replaced during installation of the HFST, however ensuring the

surface profile requirements of 2A and 2B are still met.

A. Concrete. Do not perform surface preparation or installation of HFST on concrete less than 28 days of age. Ensure that traffic paint lines and surface texturing or grooving are removed. Clean the entire concrete surface by abrasive blasting or shotblasting to remove all materials that may interfere with the bonding or curing of the binder. The cleaned concrete surface must meet the *International Concrete Repair Institute Guideline 310.2R, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays and Concrete Repair,* concrete surface profile (CSP) 5. Ensure mortar is sound and sufficiently bonded to the coarse aggregate, and presents a uniform CSP necessary for adequate bond. Use a vacuum truck or oil-free moisture-free air blast to remove all dust and other loose material. Brooms are prohibited. Remove any oil or other contamination after initial cleaning.

B. Asphalt. Do not perform surface preparation or installation of HFST on asphalt less than 30 days of age. Ensure that traffic paint lines are removed. Ensure existing crack seal treatments are removed flush to the asphalt surface. Clean the entire asphalt surface by abrasive blasting or shotblasting to remove all materials that may interfere with the bonding or curing of the binder. The cleaned asphalt surface must meet the *International Concrete Repair Institute Guideline 310.2R, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays and Concrete Repair*, concrete surface profile (CSP) 5. Ensure abrasive blasting or shotblasting system is calibrated before operation on the traveled way. Use a vacuum truck or oil-free moisture-free air blast to remove all dust and other loose material. Brooms are prohibited. Remove any oil or other contamination after initial cleaning.

Verify that the compressed air used for any work is free of oil and moisture contamination in accordance with *ASTM D4285*. Use either an absorbent or a nonabsorbent white collector positioned within 24 inches of the air-discharge point, centered in the air stream. Allow air to discharge onto the collector for a minimum of 1 minute. Visually examine the collector for the presence of oil and/or water. Conduct the test at least one time per shift for each compressor system in operation in the presence of the Engineer. If air contamination is evident, adjust to achieve clean, dry air. Examine the work performed since the last acceptable test for evidence of defects or contamination due to contaminated compressed air. All cost associated with this work will be borne by the Contractor.

Control and minimize airborne dust and similar debris generated by surface preparation and cleanup to prevent a hazard to motor vehicle operation or nuisance to adjacent property. Meet the requirements of subsection 107.15.A.1 of the Standard Specifications for Construction and other applicable contract requirements regarding dust control.

3. Application. Ensure surface is visibly dry and no capillary moisture is present according to *ASTM D4263* (modified to 2 hours). Ensure handling and mixing of the binder is performed in a safe manner to achieve the desired results in accordance with the manufacturer's recommendations for a one-coat system or as directed by the Engineer. Apply the binder at a coverage rate of no less than 4 gallons per 100 square foot.

Do not place binder materials if weather or surface conditions are such that the material cannot be properly handled, placed, and cured within the manufacturer's requirements and specified requirements of traffic control. In the event of unexpected precipitation all uncured HFST must be immediately covered and protected with plastic sheeting. Ensure areas

exposed to precipitation or that have cured prior to receiving broadcast aggregate are removed and replaced at no additional cost to the Department.

A. Mechanized Binder Application. Apply the binder by a truck or trailer mounted application machine that is capable of continually mixing and delivering the binder components on demand within the temperature range specified in varying widths at a uniform application thickness. Ensure that the mechanically applied distributing equipment includes accurate measuring devices and/or calibrated containers and thermometers for measuring the binder temperature prior to placement, should heating be required. Do not allow the binder material to separate in the mixing lines, cure, dry, or otherwise impair retention bonding of the high friction surfacing aggregate. Uniformly spread the mechanically applied binder with a notched squeegee.

B. Hand Binder Application. Ensure that after the binder mixture has been prepared for the overlay, it is immediately and uniformly applied to the pavement with a notched squeegee.

C. Aggregate Application. Apply the clean dry aggregate in such a manner as to cover the binder mixture completely within 5 minutes. No bleed through, or wet spots should be visible in the overlay. Minimize all foot traffic on the uncured binder and ensure any foot traffic will only be done with steel spiked shoes approved by the Engineer. Remove and replace applications which do not receive enough aggregate at no additional cost to the Department. Remove all loose aggregate by vacuuming or brooming after the curing period. Excess aggregate may be reused if it is clean, dry, free from foreign matter, and meets gradation requirements. Blend the excess aggregate at a ratio of 3 parts virgin material to 1 part recycled material. Inspect aggregate recovery equipment prior to reclamation operation to prevent the introduction of foreign material. Collect excess aggregate within 24 hours of placement. Do not collect excess aggregate that has been rained on or driven on.

Ensure the minimum curing periods are in accordance with the manufacturer's recommendation or longer if directed by the Engineer. Ensure HFST is applied within 24 hours of the final cleaning, and prior to opening the area to traffic. Do not allow traffic or equipment on the overlay surface during the curing period or prior to reclaiming excess aggregate.

Remove and replace any areas damaged or marred by the Contractor's operations in accordance with this special provision. All cost associated with this work will be borne by the Contractor.

Remove and replace areas as directed by the Engineer and in accordance with 20SP712D – Removal of Thin Epoxy Polymer Bridge Deck Overlay.

Provide the Engineer with all records including, but not limited to, the following for each batch provided:

- batch numbers and sizes (if applicable)
- location of batches as placed on pavement, referenced by stations (if applicable)
- epoxy yield, referenced by stations
- batch time (if applicable)
- temperature of air, pavement surface, binder components, and aggregates

- loose aggregate removal time
- time open to traffic.

4. Clean Up. At the end of the project or a minimum 7 days after the HFST has cured, remove, and dispose all loose aggregate that has shed from the epoxy binder by vacuuming or brooming. Do not re-use this aggregate.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at contract unit price using the following pay item:

Pay Item	**Pay Unit**
High Friction Surface Treatment	Square Yard

High Friction Surface Treatment includes cleaning, preparing, and applying a HFST to asphalt or concrete pavement including any protection to adjacent areas and clean-up.