

Special Specification 3037

High Friction Surface Treatment



1. DESCRIPTION

Construct a High Friction Surface Treatment (HFST) consisting of one application of a single layer of a binder resin system covered with a single layer of calcined bauxite aggregate. The binder resin system is typically comprised of an epoxy or polymer resin. HFST is only applicable for spot treatments on horizontal curves, approaches to intersections, and ramps to restore or enhance the frictional properties of the roadway to improve safety and reduce the frequency of vehicular crashes.

2. MATERIALS

- 2.1. **General.** Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of all material sources. Notify the Engineer before changing any material source or formulation. The Engineer may sample and test project materials at any time during the project to verify specification compliance.
- 2.2. **Binder Resin System.** Provide a binder resin system, meeting the requirements below, recommended by the manufacturer as suitable for use on the intended pavement surface and for the potential range of atmospheric exposure.

Table 1
Binder Resin System Requirements

Property	Test Method	Requirement	
		Minimum	Maximum
Viscosity, poises	Tex-614-J	7	30
Gel Time, minutes	Tex-614-J	10	-
Ultimate Tensile Strength, psi	Tex-618-J	2,500	5,000
Elongation at Break Point, %	Tex-618-J	30	70
Durometer Hardness (shore D)	ASTM D-2240	60	80
Minimum Compressive Strength*: 3 Hours 7 Days	Tex-614-J	1,000 5,000	- -
Cure Rate (dry through time), hours	ASTM D-1640	-	3
Water Absorption, %	ASTM D-570	-	1
Tensile Bond	Tex-614-J	250 psi min or 100% substrate failure	

*specimen size 1"X1"

Formulate the binder such that at temperatures above 77°F, the gel time should be more than 5 minutes and at temperatures below 77°F the cure time is no greater than 3 hours. Provide a table of gel time and cure rate at temperatures from 55°F to 105°F at 10°F increments to indicate the gel and cure expected at application temperature.

- 2.3. **Aggregate.** Furnish calcined bauxite aggregate meeting the requirements listed in Table 2. Provide aggregate that is clean, dry, and free from foreign matter.

Table 2
Aggregate Requirements

Property	Test Method	Requirement
Aggregate Gradation: % Passing the #4 sieve Minimum % Passing the #6 sieve Maximum % Passing the #16 sieve	Tex-401-A	100 95 5
Los Angeles (LA) Abrasion, % Max (Loss after 100 Revolutions)	Tex-410-A	10
Magnesium Sulfate Soundness, 5 Cycles, % Maximum (Stockpile Gradation)	Tex-411-A	30
Acid Insoluble, % Minimum	Tex-612-J	90
Aluminum Oxide Content, % Minimum	ASTM C-25	87

2.4. **Materials Packaging.**

2.4.1. **Binder Resin System Packaging.**

Supply resin system components in well-sealed containers clearly labeled as to the type material and the ratio of the components to be mixed by volume. Include any special mixing instructions.

On the label, show resin or hardener components, brand name, name of manufacturer, lot or batch number, temperature range for storage, expiration date, and quantity in the container. Also include any caution warnings for use.

2.4.2. **Aggregate Packaging.**

Furnish aggregates in appropriate packaging that protects the aggregate from contamination, rain, and moisture and is clearly labeled with the name of the manufacturer and location of processing

2.5. **Acceptance of Materials.** Provide an independent laboratory test report for the polymer binder and calcined bauxite aggregate that show these materials meet the requirements listed in Tables 1 and 2. Submit documentation of the in-place friction characteristics (minimum 65 FN40R in accordance with ASTM E274) of aggregate bonded to a vehicular bearing surface using the polymer binder. Supply a sample of the resin binder or components lot/batch and calcined bauxite aggregate to the Engineer prior to the start of placement to allow for testing and reporting. When the system materials are part of the National Transportation Product Evaluation Program (NTPEP) and show satisfactory performance, testing by the Engineer is not required.

3. **QUALITY CONTROL PLAN (QCP)**

Develop and follow the QCP in detail. Obtain prior approval for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP before the pre-construction or pre-paving meeting. Receive approval of the QCP before beginning production. Include the following information in the QCP:

- Names and contact information for key personnel, project superintendent, and lead technician responsible for field quality control sampling and testing;
- Equipment calibration records for metering devices and application monitoring devices;
- Procedures for storage of materials for both stockpiled and onsite;
- Procedures for blending of materials;
- Procedures for preparation of surface before treatment;
- Procedures for placement for the full roadway condition to include mainlanes, shoulders, and miscellaneous areas without overlapping;
- Procedures for cleaning equipment in the field;

- Monitoring and recording ambient and surface temperatures and conditions;
- Recording of quantities of materials installed;
- Procedures for curing of HFST; and
- Corrective actions to address irregularities or unsatisfactory final surface.

4. STAFFING REQUIREMENTS

The manufacturer of the binder resin system is required to have a representative at the pre-construction and/or pre-paving meeting and at the construction site to provide recommendations and technical assistance to the Engineer and Contractor personnel before placement of the HFST and as necessary during the surface preparation, material placement and during any necessary corrective actions. The manufacturer's representative must be an employee of the binder resin manufacturing company.

5. EQUIPMENT

- 5.1. **Cleaning.** Use equipment for surface cleaning operations where applicable, in accordance with Item 738, "Cleaning and Sweeping Highways." Use other cleaning equipment required in this specification.
- 5.2. **Automated Application.** If used or required, provide automated or semi-automated application equipment to apply resin binder and automated equipment to apply aggregate.
- 5.3. Automated resin binder equipment must:
- utilize continuous pumping and portioning devices that blend the polymer binder within a controlled system
 - be capable of producing real time data flow showing the volume of binder resin and the average binder resin mil thickness throughout the application width.
 - be capable of applying the minimum binder spread rate per the recommendation from the manufacturer of the binder resin system and according to this specification; and
 - be capable of applying up to a continuous 12 ft. width application.
- 5.4. Semi-Automated resin binder equipment must:
- utilize continuous pumping and portioning devices that blend the polymer binder within a controlled system;
 - be capable of applying a binder volume to achieve the minimum binder spread rate per the recommendation from the manufacturer of the binder resin system and according to this specification;
 - may use manual means to spread binder to the binder spread rate per the recommendation from the manufacturer of the binder resin system and according to this specification, such as using serrated edge squeegees and workers wearing spiked shoes; and
 - be capable of applying up to a 12 ft. width application.
- 5.5. Automated aggregate spreader equipment must:
- be capable of applying the calcined bauxite aggregate while the resin is fluid and before the gel time of the binder applied on the pavement;
 - apply a quantity of aggregate to completely saturate the surface such that no uncovered binder is visible; and
 - apply up to a continuous 12 ft. width application.
- 5.6. The binder and aggregate application may be applied by one integrated vehicle.

6. CONSTRUCTION

6.1. **General.** Place materials only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. Do not apply the binder resin on a wet surface, when the surface temperature is below 55°F, or the ambient temperature is above 105°F unless the manufacturer provides test data demonstrating gel time of 5 minutes minimum and a cure rate (dry through time) of 3 hr. maximum when cured at representative temperatures. Do not apply the polymer binder when the anticipated weather conditions would prevent the proper application of the surface treatment as determined by the manufacturer's representative. Do not place the HFST with visible moisture on the prepared surface. Test for moisture in the pavement by taping an 18"x18" plastic sheet to the pavement per ASTM D4263. A 2-hour minimum test duration is allowed in lieu of the 16 hours specified in ASTM D4263. Perform the plastic sheet test only when surface temperatures and ambient conditions are within the established parameters for application of the overlay system. In the event of rain, allow the pavement to air dry for a minimum of 24 hr. prior to performing the plastic sheet test.

6.2. **Surface Preparation.** When applying HFST on new pavements or over areas that have been recently crack sealed, wait a minimum of 30 days after placement of the underlying surface or crack sealant. All patching materials for concrete surface shall be free of Magnesium Phosphate.

Protect utilities, drainage structures, curbs, and any other structure within or adjacent to the treatment location against the application of the surface treatment materials. Adequately cover expansion joints and deck drains prior to applying HFST. Remove covering from all covered areas immediately before the binder resin starts to cure.

Cover and protect existing pavement markings that are adjacent to the application surfaces as directed. Remove existing or temporary pavement markings that are within the surface application area in accordance with Item 677, "Eliminating Existing Pavement Markings and Markers," except for Measurement and Payment.

Clean asphalt pavement surfaces using mechanical sweepers and high pressure air wash with sufficient oil traps. Mechanically sweep all surfaces to remove dirt, loose aggregate, debris, and deleterious material.

Clean concrete pavement surfaces by shot blasting and vacuum sweeping. Shot blast all surfaces to remove all curing compounds, loosely bonded mortar, surface carbonation, and deleterious material. Ensure the prepared surface complies with the International Concrete Repair Institute (ICRI) standard for surface roughness CSP 5.

For pavement surfaces contaminated with oils, greases, or other deleterious materials not removed by the surface preparation, wash with a mild detergent solution, rinse with clean potable water, and dry using a hot compressed air lance.

Treat cracks greater than 1/4 in. in width and depth with the mixed binder resin system, unless otherwise directed by the Engineer. Installation of the HFST may proceed immediately after treating these cracks with no minimum amount of time required for waiting. Do not treat cracks less than 1/4" in. in width and depth before placement of the HFST.

When the Engineer allows the application equipment to drive on the pavement after surface preparation, provide precautions acceptable to the Engineer to ensure that the surface will not become contaminated. If traffic is allowed on the surface after surface preparation, a visual inspection by the manufacturer and Engineer must be performed to determine if additional surface preparation is needed before applying material.

6.3. **Control Strip.** When directed by the Engineer, construct a control strip of HFST before starting any production work. The control strip is required to meet the following:

- Included in the measurement and payment per requirements in Sections 7 and 8;
- Minimum width of 12 ft. and length of 20 ft. within the limits of the project; and
- Constructed using the same equipment as the anticipated production work.

Replicate field conditions, including ambient and surface temperatures, anticipated for the production work. Demonstrate surface preparation requirements. Remove pavement markers within the area to receive HFST, for the lane and length involved, prior to placing polymer binder resin system. Document the settings on the applicator equipment, initial quantities of polymer binder resin and calcined bauxite aggregate, and unused quantities of resin and aggregate remaining in the applicator equipment after applying the HFST. Determine the dry through time for the polymer binder resin system.

- 6.4. **Mixing and Application Methods.** Use a manual mixing and application, automated or semi-automated application process to apply the HFST. Construct a control strip to demonstrate the proposed application process. Use an automated process for areas greater than 250 square yards.

- 6.4.1. **Automated Application.** Use automated or semi-automated application equipment to apply the resin binder and calcined bauxite aggregate in one continuous application pass.

Blend and mix the binder resin using the ratio specified by the manufacturer (+/- 2% by volume) and continuously apply once blended. Ensure mixing is complete and does not entrain air in the binder. Apply the binder resin to a uniform thickness of 50-65 mils (25-32 ft²/gal).

Apply the calcined bauxite to the binder on the road surface while the resin is fluid and before the gel time of the binder applied on the pavement. Apply aggregate with a method approved by the binder resin manufacturer and the Engineer with equipment capable of dispensing the aggregate onto the roadway in a uniform manner. Apply a quantity of aggregate to completely saturate the surface such that no uncovered binder is visible. Do not compact or force embedment of the calcined bauxite with a roller of any type or size after placement.

Do not allow the mixed material to separate, cure, dry, be exposed or otherwise harden in such a way as to impair retention and bonding of the high friction surfacing aggregate. Remove and replace any section of wet, uncured resin that is contacted by foreign material or becomes contaminated at the contractor's expense.

- 6.4.2. **Manual Mixing and Application.** Manual mixing and application is allowed for individual areas less than 250 square yards. Manually-mix the binder resin in accordance with the manufacturer's recommendations. Apply the binder resin to a uniform thickness of 50-65 mils (25-32 ft²/gal).

Uniformly spread the binder resin onto the surface using a serrated edge squeegee and wearing spiked shoes. Minimize walking, standing, or any form of contact or contamination of the wet uncured binder resin system prior to the application of the calcined bauxite.

Immediately apply the calcined bauxite aggregate on the binder on the road surface by broadcasting until refusal while the resin is fluid and before the gel time of the binder applied on the pavement. Apply a quantity of aggregate to completely saturate the surface such that no uncovered binder is visible. Do not compact or force embedment of the calcined bauxite with a roller of any type or size after placement.

- 6.5. **Placement.** On roadways with higher degrees of transverse cross slope or longitudinal grade, maintain the specified thickness of the HFST throughout the entire area to be treated (ensure thickness is maintained on the high side of slope/grade). Ensure proper precautions are in place to keep the base binder resin from running across or down the pavement to the low point of the roadway.

- 6.6. **Cleanup.** Remove excess and loose aggregate from the traveled way and shoulders by street sweeping. When directed by the Engineer, sweep a second time after 24 hr. to one week of application. Recovered calcined bauxite aggregate may be reused only once. Verify the recovered aggregate is clean, uncontaminated, and dry prior to any reuse. Recovered aggregate must be blended with new aggregate at a rate of 2:1 (two parts of new bauxite to one part recovered bauxite). Provide a written record of the recovered aggregate and mark containers holding the recovered aggregate as "Recovered Bauxite" with the project number.

- 6.7. **Curing.** Cure the HFST in accordance with the manufacturer's recommendation. Protect treated surface from traffic until the area has cured.

7. MEASUREMENT

High Friction Surface Treatment will be measured by the square yard of completed and accepted work. No deduction will be made for the areas occupied by manholes, inlets, drainage structures, pavement markings, or by any public utility appurtenances within the area.

This is a plans quantity item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2, "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

8. 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 price bid for "High Friction Surface Treatment." This price is full compensation for surface preparation, joint and crack treatment, furnishing, preparing, hauling and placing materials including epoxy binder, removing existing pavement markings and excess aggregate as needed, and for labor, tools, equipment, and incidentals.