FRICTIONAL MASTIC SURFACE TREATMENT

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Application of an asphalt-aggregate Frictional Mastic Surface Treatment, herein after referred to as FMST as a roadway surface preservation treatment, consisting of an engineered mixture of fine aggregates, clay, polymers, other additives, and an asphalt emulsion.

1.2 REFERENCES

A. **AASHTO Standards**:

R 5 Selection and Use of Emulsified Asphalts

T 11 Materials Finer than 75 µm (No. 200) Sieve in Mineral Aggregate

T 27 Sieve Analysis of Fine and Coarse Aggregates

T 84 Specific Gravity and Absorption of Fine Aggregate

T 96 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

T 308 Determining the Asphalt Binder Content of Hot-Mix Asphalt (HMA) by the Ignition Method.

T 327 Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus.

B. **ASTM Standards**:

C 117 Materials Finer Than 0.075mm (No. 22) Sieve in Mineral Aggregates by Washing

C 136 Sieve Analysis of Fine and Coarse Aggregates

D 5 Penetration of Bituminous Materials.

D 244 Emulsified Asphalts.

D 2196 Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield Type) Viscometer

D 6934 Residue by Evaporation of Emulsified Asphalt

D 6937 Determining Density of Emulsified Asphalt.

E 1911 Measuring Paved Surface Frictional Properties Using the Dynamic Friction Tester.

C. **ISSA Standards**:

ISSA Specifications and Guidelines, Current Edition

TB 100 Wet Track Abrasion of Slurry Surfaces, Modified.

1.3 SUBMITTALS

A. Experience Reports: If requested by ENGINEER, submit the following.

1. List of five (5) projects that have successful product application on bituminous surfaces. Provide names of project contacts.

2. Source and field quality control testing reports performed by CONTRACTOR and Suppliers.

B. Mix Design: Submit the following. Allow ENGINEER 10 days to evaluate the submittal.
   1. Date of mix design. If older than 60 days from date of submission, recertify mix design.
   2. Proportions of aggregate, filler, water, polymer, and emulsion in the mix.
   3. Residual in-place bitumen content, in ***pounds per square yard***.
   4. Residual in-place aggregate or mineral solids content, in ***pounds per square yard***.
   5. Thickness target for each application coat, in ***gallons per square yard***.
   6. Total minimum thickness, in ***gallons per square yard***.
   7. Results of a wear resistance or wet track abrasion test current within one (1) calendar year of the proposed mix design.

C. Asphalt/polymer emulsion
   1. Test report, meet the requirements of this Section, article 2.2.
   2. Certificate of analysis and compliance from the manufacturer for each batch.

D. Test reports for aggregate.
   1. Refer to this Section, article 2.3.

E. Changes in the job mix gradation.
   1. Submit a written request for a change in the job mix gradation.

F. Before Placement: Submit 48 hours before delivery.
   1. Traffic control plan, Section 01 55 26.
   2. List of construction equipment to be used.
   3. Certification from emulsion supplier stating emulsion meets requirements in this section.
   4. Names, certification levels, and years of experience of testing agency's field technicians that are assigned to the Work.
   5. Name and certifications of laboratory to be used for testing.
      a. Laboratory must comply with ASTM standards.
   6. Warranty.

G. Quality Control Data as per Article 3.6

1.4 QUALITY ASSURANCE

A. Foreman of CONTRACTOR's crew or Supplier's representative has completed at least three (3) projects of similar scope. If crew foreman does not have such experience, Supplier must provide a full-time representative on site during application.

B. Use a laboratory that complies with ASTM D 3666 and follows Section 01 45 00 requirements.

C. Contractor must complete certification program from licensed FMST manufacturer and be approved and certified to apply material from licensed manufacturer of FMST.

D. Verify mixture delivered to site contains the same emulsion specified in the mix design.

E. Do not change source of the asphalt emulsion or aggregate without supporting changes in the mix design.

F. Reject product or work that does not meet requirements of this section.

1.5 WEATHER

A. Temperature:

1. Apply surface treatment material if air and pavement surface temperatures in the shade is 55 deg F and rising.
2. Cease application if air or pavement surface temperatures are projected to fall below 45 deg F within 24 hours.

B. Moisture and Wind:

1. Do not apply surface treatment material to a wet surface (no visible standing water or high sheen), during rain, 24 hours prior to forecast rain, or in unsuitable windy weather.
2. Cease work if weather or other conditions prolong opening pavement surface to traffic.

1.6 NOTICE

A. Follow Laws and Regulations concerning when and to whom notices are to be given at least three (3) days before applying surface treatment material.

B. Indicate application time and when new surface can be used. If necessary, include a map showing closed-off areas.

C. Provide phone numbers of at least two (2) individuals who represent the CONTRACTOR who can be reached at any time during the work.

D. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

E. Should work not occur on specified day, issue an updated notice.

1.7 ACCEPTANCE

A. General**:**

1. Acceptance is by Lot.
2. Acceptance is performed by the Engineer through review and approval of the submitted Quality Control data and yield calculations. The Engineer may perform additional sampling, testing and verification of any portions of the placement that do not appear to meet requirements.
3. Dispute resolution, Section 01 35 10.
4. Opening surface treatment to vehicular traffic does not constitute acceptance.
5. Observation of CONTRACTOR’s field quality control testing does not constitute acceptance.

B. Frictional Mastic Surface Treatment Thickness:

1. Lot size is one (1) day's production. Sub-lot size is one truck placement.
2. If yield tests indicate average application rate for any sub-lot is more than 0.02 gallons per square yard below target, apply additional coat of FSMT to meet or exceed target thickness at no additional cost to OWNER.

C. Placement:
   1. Mat appearance.
      a. No runoff onto concrete curbs, gutter pans, and shoulders.
      b. No streaking, drilling, drag marks, or squeegee marks.
      c. No light spots.
      d. No de-bonding.
      e. Straight longitudinal edges with proper joints.
   2. Correct mat placement deficiencies at no additional cost to OWNER.

1.8 WARRANTY

A. Both the CONTRACTOR and Supplier shall provide a two (2) year minimum written warranty when the existing pavement is in an appropriate condition (CONTRACTOR and Supplier to determine condition). Warranty covers delaminating, peeling and pre-mature surface wear.
   1. Before placement, notify ENGINEER if pavement condition or application condition voids the warranty.
   2. ENGINEER may allow or cancel product application at no cost to OWNER if warranty cannot be given.

B. Acceptable performance after two (2) year period is no delaminating, peeling, or inter-aggregate loss in surface wear. Mechanical disturbances by snow plow chatter, studded tires, etc. are excluded from warranty. Repair defective coverage at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 ASPHALT BINDER

A. Crack Pouring Asphalt: Rubberized asphalt or asphalt rubber hot pour, Section 32 01 17.

B. Tack Coat: SS-1 or CSS-1, Section 32 12 13.13. Use a tack coat that is compatible with seal coat application.

C. Emulsified Asphalt incorporated in: Grades SS-1, SS-1H, CSS-1, or CSS-1h according to AASHTO R 5 and Table 1.

Table 1 – Physical Properties

Criterion	Standard	Min	Max
Tests on Emulsion			
Viscosity at 25 deg C, seconds	D 244	15	100
Particle Charge Test (a)		Positive	
Residue by distillation, percent		57	--
Tests on Residue from Evaporation			
Penetration at 25 deg C, 100 g, 5 seconds	D 5	15	150
NOTES			

(a) In case of inconclusive particle charge, material having a pH value of 6.0 will be acceptable as a CSS type.

2.2 AGGREGATE

A. Material:

1. Clean and free from organic matter or other detrimental substances.
2. Light weight with the following properties.

Table 2 - Aggregate Properties

Criterion	Standard	Min	Max
Water absorption, percent	T 84	--	10
Micro-Deval, percent (b)	T 327	--	20

NOTES
(a) Test results are on aggregate received before blending into sealer.
(b) Micro-Deval wear of aggregate retained on No. 60 sieve.

B. Gradation: Analyzed on a dry weight and percent passing basis.

1. Material passing any sieve and retained on the next consecutive sieve is 45 percent maximum.
2. Target Grading Curve must lie within the Master Grading Band.

Table 3 - Master Grading Band and Target Tolerance Limits

Sieve	Standard	Master Grading Band Limits Percent Passing [a]	Production Tolerance [b]
No. 8		100	
No. 16		80 - 100	+/- 5
No. 30	C136	75 - 100	+/- 5
No. 60		50 – 85 [c]	+/- 5
No. 100		40 - 65	+/- 5
No. 200	C117	25 - 65	+/- 5

NOTES
(a) Test results are on aggregate received before blending into sealer.
(b) Production tolerance is the allowable variation from the Target Grading Curve during production.
(c) Provide gradation such that FMST contains a minimum of 18 percent aggregate above the No. 60 sieve, by weight of the wet mixture.

2.3 ADDITIVES

A. Use water that is clean, non-detrimental, and free from salts and contaminant.
B. Use a minimum of 14% polymer solids content, by weight of asphalt binder.
C. Use clays, other additives as necessary to achieve mix design performance.

2.4 MIX DESIGN

A. Select type and grade of emulsified asphalt, AASHTO R 5.
B. Select set and cure time to meet opening to traffic requirements.

C. Provide a mix meeting the following requirements.

1. Use the same materials and aggregate gradation to be used on the project.
2. Do not change source of the asphalt emulsion and aggregate without supporting changes in the mix design.

Table 4 – Mix Properties

Test	Standard	Min	Max
Tests on Mix			
Weight per gallon, pounds (a)	ASTM D 6937	Report	
Solids content by evaporation at 130 C, percent (b)	ASTM D 6934	48	--
Rotational Viscosity @ 20 RPM / RV spindle, (cPs) @ 25 C	ASTM D 2196	800	4000
Tests on Residue from Evaporation			
Asphalt binder content of cured mix, (130 deg C method), percent (b)	AASTHO T 308	30	--
Mineral aggregate and fines content of cured mix (130 deg C method), percent (b,c)	AASHTO T 308	50	--
Wet-track abrasion loss, (72 hour soak), g/m^2 (e)	ISSA TB 100 Modified	--	80
Asphalt content by ignition method, percent (b,c)	AASHTO T 308	30	--
Dynamic friction test number, 20 km/h (b,d)	ASTM E 1911	> 90 percent of base value	

NOTES

(a) Use the modified method to account for a fine emulsion mixture. Required for calibration of application equipment and for field control and acceptance

(b) A 500 to 1000 gram representative sample of the mix shall be dried in a suitable oven until weight loss ceases. Solids content shall then be defined as the net residual weight divided by net original weight expressed in percent. Retain this residual dried mix for AASHTO T 308 tests if required.

(c) Due to the high binder content of the mix the sample size processed in the ignition oven may need to be adjusted to not exceed the binder content allowable for a particular model ignition oven. IMPORTANT: This test should be performed on a completely dry sample.

(d) Establish base friction value using prepared laboratory compacted slab of any ENGINEER approved mix as surface to be tested. The Dynamic Friction Test (DFT) number ratio should indicate that after application of the mastic seal, the surface retains required minimum percentage DFT number of the original pavement surface. Based on a minimum of three (3) slabs with three (3) measurements per slab. Value for information only. Will not be used for project control.

(e) See UDOT for Guidelines for Modifications of ISSA TB 100

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Paver: Use a continuous-flow mixing unit.
   1. Capable of applying at least 15,000 square yards of material per day.
   2. Equipped with full sweep agitation system to assure proper suspension of fine aggregates.
   3. Equipped with an operator control station that adjusts material spread rate in accordance with project calibration process.
   4. Equipped with a filtering system to catch particles that plug nozzles.
   5. Equipped with a retractable spray bar capable of applying mixture without drilling. The bar should be positioned to meet calibration requirements.

B. Storage Tanks:
   1. When delivering mix from the central mixing plant to a job site storage tank, use only storage tanks with a capacity to contain the entire transport load.
   2. Ensure that all site storage tanks have internal full sweep mixing mechanisms and mixing capability that can provide at any given point in the tank a homogenous mix.

3.2 PREPARATION

A. Paver Calibration: On a test strip at least 300 feet long, determine the correct pump settings, spray bar height, and ground speed for the application equipment. Apply material with pump settings at 80 percent of maximum output (plus or minus 5 percent) and a ground speed of 300 to 400 feet per minute.
   1. Do not begin or continue application without ENGINEER's knowledge of the calibration process and equipment settings.
   2. Do not deviate from calibration settings without ENGINEER's knowledge.

B. Surface Repair: Method of payment to be determined by ENGINEER if any of the following repairs are required.
   1. Raising low areas to grade, lowering high areas to grade, hole patching, inlays.
   2. Providing tack coat on highly absorbent, polished, oxidized, or raveled asphalt surfaces or on brick and concrete surfaces.
   3. Crack sealing and crack repairing, Section 32 01 17.
   4. Pushing or shoving pavement repairs.
      a. Mill damaged area at least three (3) inches below required surface elevation.
      b. Install and compact three (3) inches of asphalt concrete (grade designated by Engineer).

C. Masking: Mask-off Street Fixtures, end of streets, intersections.

D. Traffic Control:
   1. Implement traffic control plan requirements. Provide safe passage for pedestrians and vehicles. Do not proceed without flaggers if work requires maintaining two-way vehicular traffic.
   2. Remove all thermoplastic plastic and pavement marking tape. If existing markings and stripes are to be reestablished, use reflective tabs to mark existing locations before applying surface treatment material. Unless specified otherwise, costs are not included in the work of this section.

E. Cleaning:

1. Remove loose material, mud spots, sand, dust, oil, vegetation and other objectionable material.
2. Do not flush water or apply pressurized water over cracked pavement unless ENGINEER allows its use and a sufficient time is allowed for drying.

3.3 PROTECTION

A. Trees, Plants, Ground Cover:
   1. Protect trees, plants and other ground cover from damage.
   2. Prune trees to allow equipment passage underneath, Repair tree damage at no additional cost to OWNER.

B. Protect structures, curb, gutter, sidewalks, guard rails, guide posts, etc. from physical damage.

3.4 APPLICATION

A. General:
   1. Two separate application coats are required. The first application must be thoroughly set and free of any damp areas before the second application begins.
   2. Adjust application rates according to surface conditions, only after obtaining review by ENGINEER and the asphalt emulsion manufacturer.
   3. Do not add additional water to FMST mixture, once required mix design components have been combined at the plant, and do not dilute mixture at any point, after FMST mixture has been manufactured and loaded for transport.
   4. Do not allow runoff of the FMST in any areas outside of specified application limits. Remove runoff at no cost to the OWNER.

B. Spreading:
   1. Keep material delivery at a constant rate even if forward speed of lay-down machine varies.
   2. Do not reduce application rate along edges or around manhole covers.
   3. Apply both applications right to the edge of the pavement. Do not leave uncovered areas near curbs, Street Fixtures, or edges on either application.
   4. Make straight lines at all locations.
   5. Place product out to right-of-way line on side streets and intersections.
   6. Use hand squeegees to spread mix in areas that cannot be reached with distribution spray bar.
      a. Provide complete and uniform coverage.
      b. Avoid unsightly appearance from hand work.

C. Joints:
   1. Make transverse joints straight-cut butt type, not over-lap type.
   2. Place longitudinal joints on lane lines. Limit overlap to three (3) inches maximum.
   3. Stop and correct paving operation if longitudinal or transverse joints have uncovered areas or unsightly appearance.

D. Lines:
   1. Make straight lines along lip of gutters, shoulders, end of streets, and in street intersections. No runoff on these areas will be permitted.

2. Vary edge lines no more than one (1) inch per 100 feet.

3.5 TOLERANCES

A. Each coat thickness = **at least 40 percent of the total thickness.**

B. Total thickness = **0.30 gallons per square yard minimum**.

3.6 QUALITY CONTROL

A. Perform plant testing as per below, minimum per batch.
   1. Solids content by evaporation: 1 per batch, minimum.
   2. Rotational viscosity: 1 per batch, minimum;
   3. Asphalt binder content of cured mix: 1 per week, minimum;
   4. Mineral aggregate and fines content of cured mix: 1 per week, minimum.

B. Perform field yield calculations for each truck placed to verify application rate. Calculate to the nearest 0.01 gallons per square yard.

C. Submit the following within 2 working days of the end of placement:
   1. Summary of all plant production quality control data from time period covering production of material for the project.
   2. Yield calculations for each truck load, or portion thereof, placed on the project.

3.7 AFTER APPLICATION

A. Raise reflective tabs that were covered over by application.

B. Clean Street Fixtures.

C. Do not apply permanent pavement markings or striping material until layout and method of payment has been determined by ENGINEER and final application of surface treatment material has been in-place at least 10 days, or as permitted by ENGINEER. Layout must be verified by ENGINEER prior to application.

3.8 REPAIR

A. Remove delaminated or non-compliant product found after installation and apply acceptable product.

B. Remove spatter, mar and overcoat from curb, gutter, sidewalk, guard rails, guide posts, etc.

C. Remove overcoat from Street Fixtures.

D. Make edge and end lines straight. Provide a good appearance.

E. Leave no streaks, holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying pavement.

F. Repair collateral damage caused by construction.

3.9 OPENING TO TRAFFIC

A. Cure time depends on type of asphalt, mixture characteristics and weather. Keep traffic off surface until material does not track out.

END OF SECTION