

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
FIBER REINFORCED BITUMINOUS MEMBRANE

HCY:JAT

1 of 9

C&T:APPR:JWB:CJB:05-16-11

a. Description. The work consists of furnishing all materials, equipment, labor, and preparation necessary for the application of a fiber reinforced bituminous membrane used as a standalone finished surface (Type A) or as a stress absorbing membrane interlayer (Type B) as detailed on the plans. The applied material must completely seal the entire pavement surface and provide a uniform textured surface, suitable for placement of hot mixed asphalt or as a finished surface.

b. Materials. The materials must meet the following requirements.

1. Asphalt emulsion must meet the requirements of Table 1 and must be furnished in accordance with the certification procedures described in the *Materials Quality Assurance Procedures Manual*.

2. Coarse aggregates for fiber reinforced bituminous membrane that are not provided by a prequalified aggregate supplier must be tested materials. All aggregate must meet the gradation and physical requirements in Table 2.

3. Glass fiber must be E Class from an approved source. The glass fiber spools must be supplied internally wound, in coils or "cheeses", cut in place into 60 mm (2.38 inch) lengths and distributed uniformly across and between the two parallel applications of modified asphalt emulsion. Glass fiber spread rates must be up to 120 g/m², (4oz./SY), with additional asphalt emulsion rates of spread, depending on the site requirements.

Table 1: Chip Seal Emulsified Asphalt

Emulsion: (a)	Minimum	Maximum	ASTM Method
Viscosity, Saybolt Furol, 50°C, sec	75	400	D 88
Storage Stability, 24 hr, % Difference		1	D 244
Demulsibility, %, 35ml 0.8% Dioctyl Sodium Sulfosuccinate	50		D 244
Particle Charge	Positive		D 244
Sieve Tests, %		0.1	D 244
Distillation Residue, wt.% (b)	68		D 244
Oil in Distillate		3.0	D 244
Emulsion Residue:	Minimum	Maximum	ASTM Method
Penetration, 25°C, 100 g, 5 sec. Dmm	70	100	D 5
Ductility, 25°C, 5cm/min., cm	40		D 113
% Solubility in Trichloroethylene	97.5		D 2042
Ash Content, %		2	D 128
Elastic Recovery, 10°C, %	75		D 6084
Toughness	9.0		D 5801
Tenacity	7.0		D 5801
Dynamic Shear Rheometer, 64°C, G*/Sin delta	Report		D 6373
DSR, 64°C, delta, degrees	Report		D 6373
a. Samples of emulsified asphalt will be taken in accordance with ASTM D 140. Samples must be stored at a temperature of not less than 4°C until tested. b. Residue determination and preparation may use the alternate ASTM D 244 method, "Residue by Evaporation" so as to not destroy the properties of any polymer modifiers contained therein.			

Table 2: Gradation and Physical Requirements for Fiber Reinforced Bituminous Membrane Aggregate

Sieve Analysis (MTM 109), Total Percent Passing (a)		
Sieve Size	Type A	Type B
3/4 inch	100	100
1/2 inch	95-100	95-100
No. 4	5-25	5-25
No. 8	0-10	0-10
No. 200 (Loss by Wash)	2.0 maximum	2.0 maximum
Physical Requirements for Coarse Aggregate		
Test	Description	Specification
MTM 102	L.A. Abrasion Resistance	40 % maximum
MTM 117	Percent of Crushed Particles	100%
MTM 110	Deleterious Particles in Aggregate	1.0% maximum (b)
MTM 111 (c)	Aggregate Wear Index (AWI)	260 minimum
ASSHTO T104	Sodium Sulfate Soundness Test, 5 Cycle	15
a.	All aggregate must be washed.	
b.	Includes the sum of shale, silt stone, structurally weak and clay ironstone.	
c.	For surface course, does not apply to interlayer	

c. Equipment. Secure the Engineer’s approval for all equipment required for completion of the work prior to beginning construction. Furnish an accurate thermometer, hand brooms, and other small tools and equipment essential for the completion of the work. Maintain equipment in satisfactory operating condition throughout the life of the project.

1. Pressure Distributor/Applicator. Furnish pressure distributor/applicator equipped, maintained and operated as follows:

A. Pressure distributor equipped with a computerized rate control that automatically adjusts the distributor’s pump to the ground speed;

B. Pressure distributor capable of heating and re-circulating the bituminous binder to the specified temperature;

C. Nozzles suitable for the specified material and application rate;

D. Two spray bars, one in front of and one behind, the fiber applicator housing;

E. Fiber cutter and distributor configured as an integrated unit;

F. Integrated applicator comprised of an open-bottom spray bar housing and a fan or blower capable of producing a down draft in the housing;

G. Multiple openings in the open bottomed housing for dispensing cut glass fiber onto the surface of the previously sprayed binder material;

H. Integrated applicator calibrated within the previous 12 months for transverse and longitudinal distribution application rates according to ASTM D2995 (Practice for Determining Application Rate of Bituminous Applicator) or other suitable method;

I. Bituminous fiber applicator capable of applying bituminous materials at controlled rates of 0.22 gal/syd (1.0 l/m²) to 0.56 gal/syd (2.7 l/ m²);

J. Capable of applying fiber at rates of 1 oz/syd to 4 oz/syd; and

K. Capable of applying a uniform first layer of asphalt emulsion followed by a uniform layer of chopped-in-place glass fibers, followed by a uniform second layer of asphalt emulsion.

2. Aggregate Spreader. Furnish and use a self propelled aggregate spreader equipped with hoppers, revolving cylinders, and adjustments necessary to produce a uniform distribution of material at the specified rate.

3. Compacting Equipment. Furnish and use a minimum of two self-propelled pneumatic-tired rollers, each weighing not less than 8 tons.

4. Brooms. Furnish and use motorized brooming equipment capable of cleaning the road surface prior to treatment and removing loose particles after treatment. Use pick-up sweepers to clean road surfaces in areas adjacent to lawns and on roadways with curb and gutter.

5. Pilot Car. Furnish and use a pilot car, equipped with a sign that reads "PILOT CAR - FOLLOW ME" meeting the MDOT Sign Standard G20-4. Mount the sign in a conspicuous position on the rear of the pilot car.

6. Miscellaneous. Equip self-propelled equipment with at least one department-approved, flashing, rotating or oscillating amber light, visible to traffic in all directions. Equip chip spreaders with one such light on each side of the spreader.

d. Construction.

1. Pre-Paving Meeting. A pre-paving meeting between the Engineer and Contractor will be held on-site prior to beginning work. The agenda for this meeting includes:

A. Review work schedule;

B. Examine traffic control plan;

C. Review equipment calibrations and adjustments;

D. Inspect condition of equipment, including transport units;

- E. Submission of "Design for Intended Yield," containing the aggregate gradation, L.A. Abrasion Resistance, loose unit weight, and application rate of asphalt emulsion, fiber glass, and aggregate;
 - F. Discuss the quality control plan; and
 - G. Designation of Contractor's authorized representative.
2. Temperature and Weather Limitations. Do not place fiber reinforced bituminous membrane under the following temperature or weather conditions;
 - A. When the pavement and ambient air temperatures are less than 55 degrees F;
 - B. When the existing pavement temperature is 130 degrees F or above;
 - C. When air temperature below 40 degrees F are forecast to occur within 24 hours of completing work; or
 - D. When weather is foggy or rainy.
 3. Seasonal Limitations. Do not place Type A fiber reinforced bituminous membrane outside the following seasonal limits:
 - A. June 1 – August 15 for the Upper Peninsula
 - B. May 15 – September 1 for the Lower Peninsula north of M-46 (including M-46)
 - C. May 15 – September 15 for the Lower Peninsula south of M-46
 4. General Placement Operation.
 - A. Establish stations at 1000-foot intervals on the entire project prior to placing the treatment. Maintain stationing until the project is complete.
 - B. Complete all surface preparation that may affect the performance of the fiber reinforced bituminous membrane. Clean all pavements to be treated with a motorized power broom to remove all loose material. Use a hand broom to clean all cracks and other areas not reached by the power broom. Use pick-up sweepers in areas adjacent to lawns and on roadways with curb and gutter.
 - C. Operate vehicles and equipment involved in the fiber reinforced bituminous membrane as close to each other as practical. Ensure the aggregate covers the asphalt emulsion within 30 seconds of applications. Do not allow the aggregate spreader to trail the emulsion distributor by more than 150 feet, to ensure proper asphalt/aggregate adhesion.
 - D. Roll the aggregate after spreading. Do not allow more than 2 minutes between spread aggregate and completing the initial rolling of the aggregate. Ensure rollers proceed in a longitudinal direction at 5 miles per hour or less. Make three complete passes over the aggregate with each roller, with the final pass being in the direction of the chip

spreader.

E. Use the appropriate sweeping equipment to perform an initial sweeping before opening to traffic to remove excess loose aggregate within the construction traffic control zone. If additional sweeping is necessary, use an arrow board in bar mode, pulled behind a trailing vehicle. Ensure sweeping is sufficient to prevent migration of loose aggregate back onto any part the pavement. Use a pick-up sweeper to remove loose aggregate in areas adjacent to lawns, curbs, or intersections.

F. Post the roadway with "LOOSE GRAVEL" signs, (FHWA (W8-7)) and a 35 MPH speed plaque mounted below each sign. Place these signs at 0.5 mile maximum intervals.

G. Protect all utility castings and raised pavement markers, using tarpaper or other approved materials, prior to beginning the fiber reinforced bituminous membrane operation. Remove protective coverings prior to sweeping and opening to traffic.

H. Do not allow traffic on the new surface until it has cured sufficiently to prevent pickup by vehicle tires. Repair traffic damage to the new surface at no additional cost to the contract.

I. Plan the work so that all lanes are treated to approximately the same point at the end of each day's operation.

J. Use a pressure distributor to apply fibers and bituminous materials in a uniform, continuous spread over the section to be treated and within the specified temperature range. Sandwich the chopped-in-place fibers between the two layers of asphalt emulsion. Ensure the pressure distributor is moving forward at the proper application speed before opening the spray bar and fiber chopper bars. If any skipped areas or deficiencies occur, immediately stop the operation and correct the application process. Correct deficient areas in a manner approved by the engineer. Make junctions of spreads carefully to ensure a smooth riding surface.

K. Stockpile and load the coarse aggregate in a manner that permits ready identification of material and minimizes segregation and contamination of the aggregate. Ensure the moisture content of the coarse aggregate is below 4 percent throughout the project. Spread coarse aggregate uniformly at the specified rates, without ridges or gaps. Adjust aggregate spread to minimize excess loose particles and to provide complete coverage after rolling. Conduct the spreading operation so that the tires of trucks or the spreader do not come into contact with the newly applied bituminous material.

L. Apply emulsion for Type A fiber reinforced bituminous membrane at a rate of 0.35 gal/syd to 0.50 gal/syd (tolerance of 0.02); and apply fiber at a rate of 1 oz/syd to 3 oz/syd. Apply emulsion for Type B fiber reinforced bituminous membrane at a rate of 0.40 gal/syd to 0.55 gal/syd (tolerance of 0.02); and apply fiber at a rate of 2 oz/syd to 4 oz/syd.

Apply aggregate, at a rate recommended by the supplier of the fiber reinforced bituminous membrane binder, to produce a completed surface with no exposed binder. Ensure that the supplier of the fiber reinforced bituminous membrane binder determines the application rate for emulsion and aggregate based on the existing pavement condition and aggregate size. Report this information to the Engineer prior to beginning work and include aggregate gradation for the job specific materials.

e. Quality Control. Establish, follow, and maintain an effective quality control system, in compliance with current Department procedures, until work is accepted in accordance with this special provision. The quality control system must detail plans, procedures, and organization necessary to produce a fiber reinforced bituminous membrane that complies with the contract.

Allow the Engineer access to all work in progress for the purpose of assurance review and testing.

Prepare a contractor quality control plan adequate to ensure that the warranty related treatment complies with the contract. The plan must cover all fiber reinforced bituminous membrane operations. Submit a copy of the plan to the Engineer for approval at the pre-construction meeting. Comply with the approved plan throughout the project.

1. Quality Control Plan Minimum Content. Ensure the quality control plan addresses the following items, at a minimum:

- A. Materials used on the project;
- B. Sampling and testing methods used to determine compliance with material specifications;
- C. Equipment used on the project;
- D. Calibration method used to determine compliance with the application rates;
- E. Procedures for pavement cleaning and preparation;
- F. Controls implemented to ensure that the fiber reinforced bituminous membrane material is cured or set up satisfactorily before opening to traffic;
- G. Proposed procedure for monitoring initial acceptance requirements.

2. Coarse Aggregate. Collect one sample each day of production from the project aggregate stockpile, and perform a sieve analysis. This test result must meet the requirements of Table 2 and be within the quality control tolerances of Table 3 to substantiate the Design for Intended Yield.

Table 3: Quality Control Tolerances

Sieve Size	Tolerance
1/2 inch	- 5.0 percent
No. 4	+ 5.0 percent

3. Emulsion. Apply the asphalt emulsion at a temperature between 150 degrees F and 180 degrees F.

4. Unsatisfactory Conditions Requiring Corrective Action.

If there are adverse environmental conditions, the Contractor must provide the Engineer an action plan that clearly demonstrates how the fiber reinforced bituminous membrane operation will be adjusted for the actual environmental conditions.

If a condition is identified that causes an unsatisfactory condition as described herein, stop production work immediately and take corrective action. Complete required corrective action at no additional cost to the contract.

A. Visible Dust. During normal traffic operations, any dust that is a nuisance or even slightly impairs visibility is unsatisfactory; wet broom or lightly fog seal the roadway until the condition is eliminated. If dusty conditions cannot be controlled by other means, pre-coat the aggregate with 0.75 percent, by mass, of residual asphalt. Perform pre-coating in either a weight-batch type, continuous mixing type, or drum type hot mix plant. Use either asphalt binder (PG 64-22) or emulsion (CSS-1h) for pre-coating.

B. Loose Stone. During normal traffic operations, any stone picked off the surface by vehicles is unsatisfactory; broom or fog seal the roadway until the condition is eliminated.

C. Bleeding or Tracking. During normal traffic operations, any bleeding or moderate tracking is unsatisfactory; sand the roadway and sweep clean until the condition is eliminated. If bleeding or tracking cannot be controlled by other means, apply, roll, and broom a heated aggregate meeting the physical properties of Table 2 to the surface of the roadway.

D. Rough Joints. Bumpy or poor riding transverse or longitudinal construction joints resulting from fiber reinforced bituminous membrane application are unsatisfactory; grind the surface to remove the bump and lightly apply a fog seal over the ground area.

E. Surface Patterns. An asymmetric appearance to the fiber reinforced bituminous membrane surface, characterized by longitudinal grooves or ridges in the surface, is unsatisfactory; readjust the spray bar and nozzles to eliminate the surface pattern problem.

f. Documentation.

1. Submit a daily report to the Engineer that includes the following information:

- A. Control section/project number/county/route/Engineer;
- B. Date/detailed weather information/pavement temperature;
- C. Asphalt emulsion application temperature;
- D. Beginning and ending stations for placement and brooming;
- E. Design for Intended Yield: gradation and application rate per course for coarse aggregate, asphalt emulsion, and fiberglass;
- F. Yield checks (one per day, minimum);
- G. Aggregate gradation and moisture content (one per day, minimum);
- H. Length/width/total square yards placed;

- I. Quantity placed of "LOOSE GRAVEL" signs with 35 mph speed plaques; and
 - J. Signature of Contractor's Authorized Representative
2. Submit the following other required project documentation to the Engineer:
- A. Aggregate Certification or Shipment of Tested Stock Report (Form 1900);
 - B. Asphalt emulsion documentation in accordance with current Department acceptance procedures;
 - C. Bill of ladings for coarse aggregates and asphalt emulsion; and
 - D. Changes in the Design for Intended Yield.

g. Initial Acceptance. The initial acceptance for Fiber Reinforced Bituminous Membrane, Type A will not occur until after at least 30 days from the time of placement. Initial acceptance for Fiber Reinforced Bituminous Membrane, Type B will occur prior to application of a top course.

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

Pay Item	Pay Unit
Fiber Reinf Bituminous Membrane, Type A.....	Square Yard
Fiber Reinf Bituminous Membrane, Type B.....	Square Yard

Fiber Reinforced Bituminous Membrane, Type A includes all materials, equipment, labor for placement of a fiber reinforced bituminous membrane surface course to a pavement and the accompanying shoulders as specified on the plans. The unit price also includes all materials sampling and testing, surface preparation, brooming, and documentation.

Fiber Reinforced Bituminous Membrane, Type B includes all materials, equipment, labor for placement of a fiber reinforced bituminous membrane interlayer to a pavement and the accompanying shoulders as specified on the plans. The unit price also includes all materials sampling and testing, surface preparation, brooming, and documentation.