

**CITY OF COLUMBUS
PUBLIC SERVICE DEPARTMENT
TRANSPORTATION DIVISION**

**SUPPLEMENTAL SPECIFICATION 1511
MULTI-SEAL RESISTANT MEMBRANE**

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MULTI-SEAL RESISTANT MEMBRANE

1511.01 Description

This work shall consist of furnishing all preparation, materials, equipment, and labor necessary for the application of a surface treatment or interlayer of a Multi-Seal Resistant Membrane. Multi-Seal Resistant Membrane shall consist of a layer of sealant, emulsion, and aggregate, properly designed and proportioned, and applied to a prepared surface in a continuous and sequential manner. The three layers of materials shall be applied in a continuous sequence and by one unit operated in a continuous motion.

1511.02 Materials

The materials shall meet the following requirements:

A. Coarse Aggregate for Cover Material

The coarse aggregate shall be certified by the manufacturer and shall be included as part of the product design. Aggregate gradation and physical properties shall be stated in the design.

Sieve Analysis (Percent passing by weight)

Multi-Seal Type	19	12.5	9.5	4.75	2.36	300mm	75mm
6	100	100	100	70-90	0-20	0-5	0-2
10	100	100	90-100	10-30	0-10	0-5	0-2
12	100	90-100	50-85	5-25	0-10	0-5	0-2
18	100	75-100	20-55	0-10	0-5	N/A	0-2

(1) In millimeters, except where otherwise indicated

Coarse Aggregate Properties

Test	Result
Soundness, etc.	
Loss, sodium, sulfate, soundness test, percent maximum	15
Aggregate of soil, silt, etc., maximum percent by weight	0.5
Physical Properties	
Percent of wear, Los Angeles test, maximum (stone or gravel)	45
Percent of fractured pieces, minimum	90
Soft pieces, percent by weight, maximum	3.0
Coal and lignite, percent by weight, maximum	1.0

B. Multi-Seal Emulsion

The Emulsion shall be an asphalt based emulsion and shall be certified by the manufacturer to be suitable for the product design. Emulsion properties shall be stated in the design. Emulsion residue shall meet the requirements stated below.

Test	Minimum	Maximum	Method
Elastic Recovery, 4° C, 10 cm, % *	70	N/A	ASTM D 113
Softening Point, Ring & Ball, °C	60	N/A	ASTM D 36
Force Ductility, 4° C, 40 cm **	20 lbs./in ²	N/A	ASTM D 4

By distillation or evaporation

C. Multi-Seal Sealant

The sealant shall be asphalt based material certified by the manufacturer to be suitable for the product design. Sealant properties shall be stated in the design. Sealant shall meet the requirements stated below.

Test	Minimum	Maximum	Method
Elastic Recovery, 25° C, 10 cm, % *	85	N/A	ASTM D 113
Ductility, 25° C, 5 cm/min., cm	40	N/A	ASTM D 113
Softening Point, Ring & Ball, °C	80	N/A	ASTM D 36
Force Ductility, 25° C, 30-40 cm **	9.5 lbs./in ²	N/A	ASTM D 4

* This test is an extension of the routine ductility test. The specimen is extended 10 cm, the distressed area is severed in the middle using shears. After 1 hour at test temperature the severed ends are returned to contact and the ductilometer reading is taken.

** ASTM D 113 as modified by the addition of a load cell to the standard ductility test apparatus and using the straight-sided force ductility molds. The load cell records pounds per square centimeter. Readings are multiplied by 6.45 to yield pounds per square inch force required to extend the sample.

The properties of the sealant shall be determined from a field sample. The sample shall be taken from an application nozzle on the machine and shall include all field additives.

1511.03 Equipment

Equipment shall be safe, environmentally acceptable and capable of producing a consistent, quality product.

Multi-Seal Resistant Membrane Applicator

The Multi-Seal Resistant Membrane unit shall be capable of receiving all raw materials, storing those materials in adequate quantity and applying all materials without stopping to reload.

The unit shall include:

- A speed control used by the operator to control the travel speed of product application.
- A method for the driver to control the product placement edge from either side of the unit.
- A digital read-out in feet per minute that operates continuously and located in the operator's view.

Sealant System

The sealant system shall include as part of the continuous applicator the following:

- Minimum tank capacity of 400 gallons, insulated and capable of heating the sealant to the desired temperature
- Application rate control of the sealant that is controlled by the operator to adjust to travel speed
- Sealant system capable of completely and uniformly applying the sealant and at the rate of 75 to 200 fpm
- The sealant system shall fill all cracks and surface voids, and strike-off the sealant uniformly across the pavement
- The sealant system shall be capable of applying sealant at an application rate range of 0.25 to 0.10 gal./sq. yd.
- Sealant applicator shall be capable of placing sealant in widths of 1 to 16 feet and in any variable width while placing material
- Sealant system shall be capable of continuously mixing the sealant

Emulsion System

The emulsion system shall include as part of the continuous applicator the following:

- Minimum tank capacity of 600 gallons, insulated and capable of heating the emulsion to the desired temperature
- Ground speed control device interconnected with the emulsion applicator
- Computerized application rate control of the emulsion that automatically adjusts to the travel speed
- Emulsion system capable of accurately and uniformly applying the emulsion to the pavement and at a forward travel rate of 75 to 200 fpm
- The emulsion application shall produce a uniform thickness across the pavement and the shutoff shall be instantaneous with no excess spillage
- The emulsion system shall be capable of maintaining the specified application rate within ± 0.02 gal./sq.yd.
- Emulsion system shall be capable of placing emulsion in widths of 1 to 16 feet and adjustable while placing material

Aggregate System

The aggregate system shall include as part of the continuous applicator the following:

- Minimum hopper capacity of 4 cubic yards
- Ground speed control device interconnected with the aggregate applicator
- Computerized application rate control of the aggregate that automatically adjusts to the travel speed
- Aggregate system shall be capable of accurately and uniformly applying the aggregate and at the rate of 75 to 200 fpm
- The aggregate system shall produce a uniform application, and shall be adjustable to properly cover exposed emulsion
- The aggregate system shall be capable of maintaining the specified application rate within ± 1.0 lbs./sq. yd.
- Screen to remove oversized aggregate
- Aggregate handling system capable of delivering at a minimum 180 tons per hour
- Aggregate applicator shall be capable of placing aggregate in widths of 1 to 16 feet and in any variable width while placing material
- The aggregate system shall be capable of applying aggregate at an application rate range of 70 to 5 lbs./sq. yd.

Compacting Equipment

Self-propelled pneumatic-tired rollers, weighing no less than 8 tons shall be used.

Miscellaneous

All equipment including hand tools, thermometers, etc., shall be provided. All equipment used on the roadway shall be equipped with at least one approved flashing, rotating or oscillating amber light visible from all sides. All material storage tanks and material handling units shall be capable of heating and storing materials such not to cause damage to the material.

1511.04 Product Design

The completed product design shall contain prescribed information in the following format identified below. Highway Preservation Systems, Ltd. shall perform the completed product design and shall approve all component materials.

- a. Source of each component material
 1. Sealant
 2. Emulsion
 3. Aggregate

- b. Completed product design tests
 1. Stripping test
 2. Loss by abrasion
 3. Aggregate and binder compatibility
 4. Emulsion rate – flushing under temperature and load

5. Sealant, application temperature
 6. Emulsion, application temperature
 7. Moisture content of aggregate
 8. Product set time
- c. Aggregate
1. Gradation
 2. Physical properties
- d. Sealant and Emulsion properties
- e. Maximum expected pavement temperature and average daily traffic count including percent commercial traffic for the pavement section that the design will be used for.

1511.05 Pre-paving on site meeting

A pre-paving meeting between the Engineer and Contractor will be held prior to beginning work. The agenda for this meeting will include:

1. Review work schedule
2. Review traffic control plan
3. Review equipment calibration and adjustments
4. Review condition of materials and equipment, including transport units
5. Product Design: Coarse aggregate gradations and application rates for sealant and emulsion
6. Review quality control plan (Yield Check Methods, etc.)

1511.06 Quality Control

The Contractor shall produce a completed product that will be in compliance with the product design and the quality control tolerances. The methods described in this section shall be used by the Contractor to measure compliance. The Contractor shall maintain all quality control documentation and make available to the Engineer upon request or at completion of work.

During the progress of work, if any of the quality control test results exceed the identified quality control tolerances, the Contractor shall identify the cause and document in detail what corrective action was taken.

Aggregate – The Contractor shall sample from the project stockpile and test for gradation at a rate of one per 500 tons of aggregate used, or a minimum of one per day of product application. The quality control tolerances from the product design are listed below.

Quality Control Tolerances	
Sieve Size	Tolerance
19.0 mm	± 5.0%
12.5 mm	± 5.0%
9.5 mm	± 5.0%
4.75 mm	± 5.0%
2.36 mm	± 5.0%
300 µm	± 4.0%
75 µm	± 1.5%

Contractor shall sample the sealant and emulsion once per day of product application. Sample shall be taken in a metal quart can and delivered to the material producer.

1511.07 Temperature Limitations

The Multi-Seal Resistant Membrane shall be placed when the pavement and atmospheric temperature is 45° F or above. Placement is not permitted if there is threatening weather and temperatures are forecasted to be below 32° F within 24 hours from the time of work. Placement is not permitted if visible signs of moisture exist on the pavement surface.

1511.08 Construction

The Contractor is responsible for all surface preparation including cleaning, removal of any foreign materials and any other preparation that may affect the adhesion of the Multi-Seal Resistant Membrane.

The Contractor shall remove all loose debris from the pavement cracks or joints larger than the one-quarter inch width and clean the pavement surface with a motorized power broom to remove any loose material. Any depressions not reached by the power broom shall be cleaned using other approved methods.

The longitudinal construction joints and lane edges shall coincide with the proposed painted lane lines. Longitudinal joints shall be constructed with less than a 75mm overlap on adjacent passes and no more than 6.5mm overlay thickness as measured with a 3m straight edge. If applicable, place overlapping passes on the uphill side to prevent any ponding of water. Construct neat and uniform transverse joints with no more than a 3mm difference in elevation across the joint as measured with a 3 meter straight edge. The edge shall be neat and uniform with no more than 50mm horizontal variance in any 30 meters.

When a double seal is specified in the proposal, the Contractor shall not incorporate the sealant application on the second course. Prior to applying the second course the first course shall be properly swept and shall show no deficiencies. A cure period of one-hour minimum shall occur before placing the second course.

The Multi-Seal Resistant Membrane, when used as an interlayer, shall be cured prior to placing a bituminous overlay, micro-surfacing or other asphalt surfacing. The cured state shall be determined by the ability to sweep all loose aggregate from the surface and that no moisture is visible in the aggregate. Aggregate shall be adhered to the binder and the binder shall exhibit elastic properties with recovery when stretched. A cured state will normally occur in 1 to 2 hours after placement under normal atmospheric conditions. A tack or bond coat is not typically required when placing bituminous overlays or micro-surfacing over the interlayer. The Engineer may require a bond or tack coat when the surface of the interlayer contains dust or moisture.

Rolling shall be performed immediately after the placement of the coarse aggregate and before the emulsion has set up. No coarse aggregate shall be left unrolled for more than 3 minutes. A minimum of 1 complete rolling trip over the treated surface will be required. A complete trip is one pass forward and backward over the same path. Each additional trip shall overlap the previous trip by about one-half the width of the roller. A minimum of 2 rollers shall be used and the rollers shall proceed in a longitudinal direction at a speed not greater than 5 miles/hour.

The Contractor shall use the appropriate equipment and perform an initial sweeping of the completed surface to remove any excess loose aggregate prior to opening to uncontrolled traffic and by the end of each day's work. A final sweeping shall occur within 24 hours after the pavement has been open to traffic. Pickup type sweeper shall be used in lawn and curbed areas where an aggregate shoulder does not exist. Loose aggregate shall not be swept into lawns, curbed areas and intersections. Water shall be used during all sweeping operations to control dust.

Before opening to traffic, the Contractor shall post the roadway with "LOOSE GRAVEL" signs, FHWA (W8-7). These signs shall be spaced at a maximum of 1/2 mile intervals for City streets and 1 mile intervals for rural streets.

The Contractor shall inspect the Multi-Seal Resistant Membrane during the application process for deficiencies. This includes workmanship, overlap on longitudinal and transverse construction joints, flushing, surface patterns, complete fill of cracks and joints, loss of aggregate and sweeping. The Contractor shall correct any and all deficiencies found.

The Contractor shall protect all utility castings using tarpaper or other approved material. Casting covers shall be removed prior to sweeping and opening to full use.

The Contractor shall protect the new surface from potential damage at intersections and driveways. Any damage by traffic to the Multi-Seal Resistant Membrane shall be repaired by, and at the Contractor's expense.

The Contractor shall notify all residents and businesses on the pavement section to be treated one week in advance of the work. The notice shall include a description of the work to be performed on the Contractor's letterhead with a company phone number for

the public to contact. This notice shall be provided and approved by the Engineer at the pre-construction meeting.

1511.09 Application

The Contractor shall apply the sealant, emulsion and aggregate within a total time lapse of 10 seconds over a specific point. The sealant shall be applied to provide full width coverage and as required to fill the pavement voids and cracks and at a temperature between 300° F and 390° F. The emulsion shall follow at the designed rate and at a temperature between 150° F and 200°F. A uniform application of coarse aggregate shall cover the emulsion prior to emulsion break and provide complete coverage. Streaking in the Multi-Seal Surface will not be permitted. If streaking occurs the Contractor shall cease operation until the deficiencies have been corrected.

Areas not accessible to the equipment shall be performed by applying the emulsion and aggregate by hand spraying and spreading. Any cracks that exist in these areas shall be filled with the emulsion prior to sealing the pavement surface. Compaction shall be used following the standard method.

EMULSION

The Contractor shall submit a design that identifies the emulsion application rate based on the gradation of the coarse aggregate and the application rate range of sealant. If during the progress of work the Contractor determines the design rate of the emulsion application requires change, the change shall be documented.

COARSE AGGREGATE

Coarse aggregate shall be applied as necessary to provide full coverage of the emulsion. No tracking of the emulsion shall occur by the rollers. The Contractor shall adjust the rate of aggregate placed to provide a minimum of loose aggregate.

1511.10 Documentation

The Contractor shall provide the Engineer a daily report with the following information:

- Control Section / Project Number / County / Route / Engineer
- Date / Air Temperature / Pavement Temperature / Humidity
- Sealant and Asphalt Emulsion Temperature
- Beginning and Ending Stations of the completed work
- Yield Checks on Emulsion rate (3 per day, minimum)
- Yield Checks on Sealant rate (3 per day, minimum)
- Aggregate Gradation (1 per day, minimum)
- Length / Width / Total Square Yards
- Contractor's Signature

1511.11 Method of Measurement

Multi-Seal Resistant Membrane will be measured by the square yard as provided for in the Contract Documents. The accepted quantities, measured as provided for above, will be paid for at the contract unit price.

1511.12 Basis of Payment

Multi-Seal Resistant Membrane shall be paid for per square yard for furnishing all materials, equipment, labor, designs, surface preparation, sweeping, and documentation necessary to complete the work as specified.

<u>Item</u>	<u>Description</u>	<u>Unit</u>
1511	Multi-Seal Resistant Membrane Type 12 Interlayer	Square Yard