ITEM 08685.0815XX M - EPOXY REFLECTORIZED PAVEMENT MARKINGS (CROSS HATCHING) 38 mm (WET NIGHT VISIBILITY SPHERES)

DESCRIPTION:

Under this work the contractor shall furnish and apply epoxy reflectorized pavement markings (cross hatching) in accordance with these specifications, the Contract Documents, the NYSMUTCD, or as ordered by the Engineer.

The epoxy marking material shall be hot-applied by spray methods onto bituminous and portland cement concrete pavement surfaces at the thickness and width shown on the Contract Documents. Following a simultaneous application of Type I and Type II glass beads, the cured epoxy marking shall be an adherent reflectorized stripe that will provide wet night reflectivity.

MATERIALS REQUIREMENTS:

A. Epoxy Material

1.0 Composition

The epoxy resin composition shall be specifically formulated for use as a pavement marking material and for hot-spray application at elevated temperatures. The type and amounts of epoxy resins and curing agents shall be at the option of the manufacturer, providing the other composition and physical requirements of this specification are met.

The epoxy marking material shall be a two-component (Part A and Part B), 100% solids type system formulated and designed to provide a simple volumetric mixing ratio (e.g. two volumes of Part A to one volume of Part B).

The epoxy marking material shall be supplied as either a regular-dry or a slow-dry material. Regular-dry may be used for all marking patterns. Slow-dry material is intended for marking hatchlines, edgelines, and other marking patterns located out of the general path of traffic.

Part A of both white and yellow shall conform to the following requirements:

**PERCENT BY WEIGHT OF PART A**

<table>
<thead>
<tr>
<th>Color</th>
<th>Pigment</th>
<th>Epoxy Resin</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHITE</td>
<td>*Pigment - 18 Minimum, Titanium Dioxide (ASTM D476, Type II)</td>
<td>75 to 82</td>
</tr>
<tr>
<td></td>
<td>Epoxy Resin - 75 to 82</td>
<td></td>
</tr>
<tr>
<td>YELLOW</td>
<td>*Pigment - 23 Minimum, Medium Chrome Yellow (ASTM D211, Type III)</td>
<td>70 to 77</td>
</tr>
<tr>
<td></td>
<td>Epoxy Resin - 70 to 77</td>
<td></td>
</tr>
</tbody>
</table>

*The entire pigment composition shall consist of either titanium dioxide or medium
chrome yellow. No extender pigments are permitted. The white pigment, upon analysis, shall contain a minimum of 16.5% TiO₂ (100% purity). The yellow pigment, upon analysis, shall contain a minimum of 20% PbCrO₄ (100% purity).

The epoxy content of the epoxy resin in Part A will be tested in accordance with ASTM D1652 and calculated as the weight per epoxy equivalent (WPE) for both white and yellow. The epoxy content will be determined on a pigment free basis. The epoxy content (WPE) shall meet a target value provided by the manufacturer and approved by the Director, Materials Bureau. A ±50 tolerance will be applied to the target value to establish the acceptance range.

The amine value of Part B shall be tested in accordance with ASTM D2074* to determine its total amine value. The total amine value shall meet a target value provided by the manufacturer and approved by the Director, Materials Bureau. A ±50 tolerance will be applied to the target value to establish the acceptance range.

*The manufacturer may specify an alternate test method for determining the amine value subject to the approval of the Director, Materials Bureau.

2.0 Physical Properties of Mixed Components (Part A & Part B)

Unless otherwise noted, all samples are to be prepared and tested at an ambient temperature of 23±2°C

a. **Color.** The white epoxy composition, when applied at a wet film thickness of 0.38 ± 0.02 mm and allowed to cure, shall be a reasonable visual match to Munsell Book Notation N9.5/0 (ASTM D1535).

The yellow epoxy composition, when applied at a wet film thickness of 0.38 ± 0.02 mm and allowed to cure, shall be a reasonable visual match to Munsell Book Notation 10YR 8/14 (ASTM D1535).

b. **Directional Reflectance.** The white epoxy composition (without glass spheres) shall have a daylight directional reflectance of not less than 84% relative to a magnesium oxide standard when tested in accordance with ASTM E1347.

The yellow epoxy composition (without glass spheres) shall have a daylight directional reflectance of not less than 55% relative to a magnesium oxide standard when tested in accordance with ASTM E1347.

c. **Drying Time (Laboratory).** When tested in accordance with ASTM D711 as modified below, regular-dry epoxy marking material shall reach a no-pick-up time in 30 minutes or less. Under these same test conditions, slow-dry epoxy marking
material shall reach a no-pick-up time in 60 minutes or less. A Bird Applicator or other suitable instrument shall be used to spread a uniform 0.38 ± 0.02 mm thick wet film.

Type I reflective glass spheres shall be immediately dropped onto the epoxy composition, followed by application of Type II glass spheres. Each type shall be applied at the rate of 1.2 kg/L of epoxy (total 2.4 kg/L).

d. **Drying Time (Field).** When installed at 25°C at the specified wet film thickness and reflectorized with Type I and Type II glass spheres, regular-dry and slow-dry epoxy markings shall reach a no-track condition in approximately 30 minutes, and 60 minutes, respectively.

Dry to "no-tracking" shall be considered as the condition where no visual deposition of the epoxy marking to the pavement surface is observed when viewed from a distance of 15 m, after a passenger car is passed over the line.

e. **Abrasion Resistance.** The wear index of the composition shall not exceed 82 when tested in accordance with ASTM C501 using a CS-17 wheel and under a load of 1000 grams for 1000 cycles. Samples shall be allowed to cure for not less than 72 hours nor more than 96 hours prior to testing.

f. **Hardness.** The epoxy composition when tested in accordance with ASTM D2240 shall have a Shore D hardness of between 75 and 100. Samples shall be allowed to cure for not less than 72 hours nor more than 96 hours prior to testing.

g. **Infrared Spectrophotometer Analysis (ASTM D2621).** Samples of both Part A and Part B shall be analyzed by infrared spectrography to verify that the materials submitted for use are of an identical formulation as originally accepted by the Materials Bureau for the Department's "Approved List" of materials. Significant deviations, as determined by comparison with acceptable formulations, shall not be allowed.

B. **Reflective Glass Spheres**

Type I and Type II reflective glass spheres for drop-on application shall conform to the following requirements.

The glass spheres shall be colorless, clean, transparent, free from milkiness or excessive air bubbles, and essentially clean from surface scarring or scratching. They shall be spherical in shape and at least 70% of the glass beads shall be true spheres. Type I spheres shall be tested for roundness according to the procedural directives of the Materials Bureau. Type II spheres shall be tested in accordance with ASTM D1155, Procedure A.
The refractive index of the spheres shall be a minimum of 1.50 as determined by the liquid immersion method at 25°C.

The silica content of the glass spheres shall not be less than 60%.

The glass spheres, Type I and II, shall be coated with a silane-type adherence coating designed to interact with and adhere to epoxy pavement markings.

The glass spheres shall have the following gradation when tested in accordance with ASTM D1214.

<table>
<thead>
<tr>
<th>Type</th>
<th>U.S. Standard</th>
<th>Total %</th>
<th>U.S. Standard</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve No.</td>
<td>Passing</td>
<td></td>
<td>Sieve No.</td>
<td>Passing</td>
</tr>
<tr>
<td></td>
<td>Passing 2.00 mm</td>
<td>100</td>
<td>Passing 850 µm</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Passing 1.70 mm</td>
<td>95-100</td>
<td>Passing 600 µm</td>
<td>80-95</td>
</tr>
<tr>
<td></td>
<td>Passing 1.40 mm</td>
<td>75-95</td>
<td>Passing 300 µm</td>
<td>9-42</td>
</tr>
<tr>
<td></td>
<td>Passing 1.18 mm</td>
<td>10-47</td>
<td>Passing 180 µm</td>
<td>0-10</td>
</tr>
<tr>
<td></td>
<td>Passing 1.00 mm</td>
<td>0-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Passing 850 µm</td>
<td>0-2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C. Packaging and Shipment

Epoxy pavement marking materials shall be shipped to the job site in strong, substantial containers.

Individual containers shall be plainly marked with the following information:

1. Name of Product
2. Item Number
3. Lot Number
4. Batch Number
5. Test Number
6. Date of Manufacture
7. Date of Expiration of Acceptance (6 months from date of manufacture)
8. The Statement (as appropriate)
   Part A - Contains Pigment & Epoxy Resin
Reflective glass spheres shall be shipped in moisture resistant bags. Each bag shall be marked with the name and address of the manufacturer, the type (I or II) of glass sphere, and net weight of the material.

D. Basis of Acceptance

Only epoxy pavement marking materials from manufacturers appearing on the Department's Approved List shall be considered for acceptance. Details for obtaining Approved List status are available from the Materials Bureau.

Epoxy pavement marking materials will be sampled and tested in accordance with the procedural directives of the Materials Bureau. Samples will be taken at the manufacturing location and considered for acceptance in stock lot quantities.

Department red and green metal security seals will be placed on containers of pavement marking materials that meet specifications. The colored metal security seals serve as the evidence of acceptance for epoxy material delivered to the job site.

All acceptances of uninstalled epoxy marking material shall expire six (6) months after the date of manufacture.

Type I and Type II reflective glass spheres shall be accepted on the basis of the manufacturer's brand name or product code appearing on the Department's Approved list. Details for obtaining approved list status are available from the Materials Bureau.

EPOXY APPLYING EQUIPMENT

Mobile applying equipment for the placement of epoxy reflectorized pavement markings shall be approved by the Director (Materials Bureau) prior to the start of work.

In general, a mobile applicator shall be a truck mounted, self-contained pavement marking machine, specifically designed to apply epoxy resin materials and reflective glass spheres in continuous line patterns. The applying equipment shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. In addition, the truck mounted unit shall be provided with accessories to allow for the marking of cross hatching and other special patterns as directed by the Engineer.
At any time throughout the duration of the project, the Contractor shall provide free access to his epoxy applicating equipment for inspection by the Engineer or his authorized representative.

The Engineer may approve the use of a portable applicator in lieu of mobile truck mounted accessories for use in applying special markings only, provided such equipment can demonstrate satisfactory application of reflectorized epoxy markings in accordance with these specifications.

Mobile applicating equipment shall be capable of installing up to 30 000 m of epoxy reflectorized pavement markings in an eight hour day and shall include the following features:

1. Individual tanks for the storage of Part A and Part B of the epoxy resin.

2. Individual tanks for the storage of Type I and Type II glass spheres. Each tank shall have a minimum capacity of 1360 kg.

3. Heating equipment of sufficient capacity to maintain the individual epoxy resin components at the manufacturer’s recommended temperature for spray application.

4. Individual dispensers for the simultaneous application of Type I and Type II glass spheres. Each dispenser shall be capable of applying spheres at a minimum rate of 1.2 kg/L of epoxy resin composition.

5. Metering devices or pressure gauges on the proportioning pumps, positioned to be readily visible to the Engineer.

6. All necessary spray equipment, mixers, compressors, and other appurtenances for the placement of epoxy reflectorized pavement markings in a simultaneous sequence of operations as described in Construction Details, D. Application of Epoxy Reflectorized Pavement Markings.

CONSTRUCTION DETAILS

A. General

All pavement markings shall be placed as shown on the Contract Documents and in accordance with the New York State, Manual of Uniform Traffic Control Devices (MUTCD).

Before any pavement marking work is begun, a schedule of operations shall be submitted for the approval of the Engineer.

At least five (5) days prior to starting striping, the Contractor shall provide the Engineer with the epoxy manufacturer’s written instructions for use. These instructions shall include, but not be limited to, material mixing ratios and application temperatures.
When pavement markings are applied under traffic, the Contractor shall provide all necessary flags, markers, signs, etc. in accordance with the MUTCD to maintain and protect traffic, and to protect marking operations and the markings until thoroughly set.

The application of pavement markings shall be done in the general direction of traffic. Striping against the direction of traffic flow shall not be allowed.

The Contractor shall be responsible for removing, to the satisfaction of the Engineer, all tracking marks, spilled epoxy, and epoxy markings applied in unauthorized areas.

When necessary the Contractor shall establish marking line points at nine (9) meter intervals throughout the length of the pavement or as directed by the Engineer.

B. Atmospheric Conditions

Epoxy pavement markings shall only be applied during conditions of dry weather and on substantially dry pavement surfaces. At the time of installation the pavement surface temperature shall be a minimum of 10°C and the ambient temperature shall be a minimum of 10°C and rising. The Engineer shall be the sole determiner as to when atmospheric conditions and pavement surface conditions are such to produce satisfactory results.

C. Surface Preparation

The Contractor shall clean the pavement and existing durable markings to the satisfaction of the Engineer.

Surface cleaning and preparation work shall be performed only in the area of the epoxy markings application.

At the time of application all pavement surfaces and existing durable markings shall be free of oil, dirt, dust, grease and similar foreign materials. The cost of cleaning these contaminants shall be included in the bid price of this item.

In addition, concrete curing compounds on new portland cement concrete surfaces and existing painted pavement markings on both concrete and bituminous pavement surfaces shall be cleaned and paid for in accordance with Section 635, Cleaning and Preparation of Pavement Surfaces for Pavement Markings.

D. Application of Epoxy Reflectorized Pavement Markings

Epoxy reflectorized pavement markings shall be placed at the width, thickness, and pattern designated in the Contract Documents.
Marking operations shall not begin until applicable surface preparation work is completed and approved by the Engineer, and the atmospheric conditions are acceptable to the Engineer.

Pavement markings shall be applied by the following simultaneous operation:

1. The pavement surface is air-blasted to remove dirt and residues.

2. The epoxy resin, mixed and heated in accordance with the manufacturer’s recommendations, is uniformly hot-sprayed onto the pavement surface at the minimum specified thickness.

3. Type I and Type II reflective glass spheres are injected into or dropped onto the liquid epoxy marking. Type I beads shall be applied first immediately followed by the application of Type II beads. Each type shall be applied at a minimum rate of 1.2 kg/L of epoxy resin (minimum total application = 2.4 kg/L).

E. Defective Epoxy Pavement Markings

Epoxy reflectorized pavement markings, which after application and curing are determined by the Engineer to be defective and not in conformance with this specification, shall be repaired. Repair of defective markings shall be the responsibility of the Contractor and shall be performed to the satisfaction of the Engineer as follows:

1. Insufficient film thickness and line width; insufficient glass bead coverage or inadequate glass bead retention.

   Repair Method. Prepare the surface of the defective epoxy marking by grinding or blast cleaning. No other cleaning methods will be allowed. Surface preparation shall be performed to the extent that a substantial amount of the reflective glass spheres are removed and a roughened epoxy marking surface remains.

   Immediately after surface preparation remove loose particles and foreign debris by brooming or blasting with compressed air.

   Repair shall be made by restriping over the cleaned surface in accordance with the requirements of this specification and at the full thickness indicated on the Contract Documents.

2. Uncured or discolored epoxy*; insufficient bond (to pavement surface or existing durable marking).

   Repair Method. The defective epoxy marking shall be completely removed and cleaned to the underlying pavement surface in accordance with the requirements of Section 635 - Cleaning and Preparation of Pavement Surfaces, at the Contractor’s expense.
The extent of removal shall be the defective area plus any adjacent epoxy pavement marking material extending one meter in any direction.

After surface preparation work is complete, repair shall be made by reapplying epoxy over the cleaned pavement surface in accordance with the requirements of this specification.

*Uncured epoxy shall be defined as applied material that fails to cure (dry) in accordance with the requirements of this specification: MATERIALS, A., 2.0 paragraph d. Drying Time (Field); or applied material that fails to cure (dry) within a reasonable time period under actual field conditions, as defined by the Engineer.

Discoloration shall be defined as localized areas or patches of brown, grayish or black colored epoxy marking material. These areas often occur in a cyclic pattern and often are not visible until several days or weeks after markings are applied.

Other defects not noted above, but determined by the Engineer to need repair, shall be repaired or replaced as directed by and to the satisfaction of the Engineer.

All work in conjunction with the repair or replacement of defective epoxy reflectorized pavement markings shall be performed by the Contractor at no additional cost to the State.

**METHOD OF MEASUREMENT**

Pavement striping (cross hatching) will be measured in meters along the centerline of the pavement stripe and will be based on a 100 mm wide stripe. Measurement for striping with a width greater than the basic 100 mm, as shown on the plans or directed by the Engineer, will be made by the following method:

\[
\text{Plan Width of Striping (millimeters)} \times \text{Meters} \div 100 \text{ mm}
\]

**BASIS OF PAYMENT**

The accepted quantities of markings will be paid for at the contract unit price, which shall include the cost of furnishing all labor, materials and equipment to satisfactorily complete the work. The cost for maintaining and protecting traffic during the marking operations shall be included in the price bid. The cost of removal of concrete curing compounds and existing pavement markings will be paid under separate items and are not included in this item.
ITEM 08685.0815XX M - EPOXY REFLECTORIZED PAVEMENT MARKINGS (CROSS HATCHING) 38 mm (WET NIGHT VISIBILITY SPHERES)

No payment will be made for the repair or replacement of defective epoxy reflectorized pavement markings.

<table>
<thead>
<tr>
<th>PAY ITEM NO.</th>
<th>ITEM</th>
<th>PAY UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>08685.081501 M</td>
<td>White Epoxy Reflectorized Pavement Stripes (Cross Hatching) 0.38 mm (Wet Night Visibility Spheres)</td>
<td>Meter</td>
</tr>
<tr>
<td>08685.081502 M</td>
<td>Yellow Epoxy Reflectorized Pavement Stripes (Cross Hatching) 0.38 mm (Wet Night Visibility Spheres)</td>
<td>Meter</td>
</tr>
</tbody>
</table>