DESCRIPTION

Under this work the Contractor shall furnish, apply, and maintain epoxy reflectorized pavement markings in accordance with these specifications, the Contract Documents, and the New York State and Federal Manuals of Uniform Traffic Control Devices. The Contractor shall warrant the performance of long-line epoxy reflectorized pavement markings for three years after the year of installation.

The Contractor shall be responsible for providing a qualified Independent Contractor who shall conduct initial and annual pavement marking performance surveys. The Independent Contractor shall measure the retroreflectivity of the long-line epoxy reflectorized pavement markings after placement using a retroreflectometer meeting these specifications. Measurements shall be taken every subsequent year for 3 years, once a year, or at the request of the Engineer, at the same areas. The Independent Contractor shall provide the Contractor and the State a report of the retroreflectivity results.

DEFINITIONS

§101 Definitions and Terms, of the Standard Specifications shall apply in addition to the following:

1. **Contractor:** Individual, firm, or corporation responsible for furnishing, applying, repairing, and maintaining the epoxy reflectorized pavement markings applied under these specifications. The Contractor shall not be a partially or wholly owned subsidiary of the Independent Contractor.

2. **Independent Contractor:** Individual, firm, or corporation, chosen by the epoxy reflectorized pavement marking Contractor. Must be qualified in the collection, statistical analysis, and reporting of retroreflectivity measurements of pavement markings. The Independent Contractor shall not be a partially or wholly owned subsidiary of the Contractor, the epoxy reflectorized pavement markings manufacturer or the reflective sphere manufacturer. The Independent Contractor shall own and operate at least one mobile retroreflectometer and at least one hand-held retroreflectometer, both meeting the requirements of this specification. The Independent Contractor shall be experienced in the calibration and operation of both types of retroreflectometers.

3. **Long-Line Epoxy Reflectorized Pavement Markings:** Epoxy reflectorized pavement markings installed as full or partial barrier lines, edge lines, or broken lane lines.

4. **Engineer:** NYS Department of Transportation representative authorized to administer the Contract.

MATERIALS
White and Yellow Epoxy Reflectorized Pavement Markings Epoxy §727-03
(except as modified by this specification)

The Department reserves the right to take field samples of epoxy reflectorized pavement marking material and/or reflective glass spheres for the purpose of laboratory testing. Field samples of epoxy pavement marking material and reflective glass spheres shall meet the requirements of this specification.

Epoxy reflectorized pavement markings and the reflective glass spheres will be accepted on the basis of the manufacturer’s brand name or product code appearing on the Department’s Approved List and the manufacturer’s certification that the materials comply with this specification.

Epoxy reflectorized pavement marking material may arrive at the project site in the tanks of the Contractor’s epoxy application equipment. Containers of epoxy reflectorized pavement marking material shipped to the project site are not required to be tagged with red and green metal security seals, or identified on their label with a NYSDOT Test Number. Epoxy pavement marking material that has exceeded the manufacturer’s shelf life or that exhibits abnormal thickening, clumping, or hardening is not acceptable.

**EQUIPMENT**

A. **Mobile Epoxy Reflectorized Pavement Markings Application Equipment:** Shall be approved by the Engineer prior to the start of work and meet the requirements of this specification.

The mobile applicator shall be:
- Truck mounted
- Self-contained
- Specifically designed to apply two-component, white and yellow epoxy reflectorized pavement markings at the manufacturer’s recommended mix ratio and material temperatures
- Maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc

It shall be equipped with:
- Proportioning pumps, metering devices, pressure gages, epoxy mixing and spraying equipment, and reflective glass sphere dispensing equipment.
- Air-blast equipment for removal of loose debris
- Individual tanks for the storage of each epoxy component and for the storage of reflective glass spheres
- Heating equipment to maintain the proper temperature for each epoxy component

It shall be capable of:
- Heating each of the epoxy components to the manufacturer’s recommended material temperature,
Installing epoxy reflectorized pavement markings at the specified mix ratio, thickness, width, and pattern.

Immediately applying reflective glass spheres uniformly across the entire width of the line at the specified coverage rate.

Installing up to 30,000 m of epoxy reflectorized pavement markings in an eight-hour day.

Applying legends, symbols, crosswalks, and other special patterns.

The Engineer may approve the use of a portable applicator in lieu of a mobile applicator to apply special markings, provided such equipment can demonstrate satisfactory application of epoxy reflectorized pavement markings in accordance with these specifications.

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.

B. Mobile Retroreflectometer: 30 meter viewing geometry “Laserlux” mobile laser reflectometer manufactured by Roadware Corp., Potter’s Industries and Advanced Retro Technology.

The mobile retroreflectometer shall be capable of:

- Continuously measuring and simultaneously recording retroreflectivity measurements while operating at normal highway speeds up to 90 km/hr, from either the left side or the right side of the vehicle.
- Measuring the retroreflectivity of the individual lines of a full barrier or partial barrier pattern.

The mobile retroreflectometer shall be field calibrated on a daily basis prior to the start of each day’s survey work. The calibration shall be performed in accordance with the manufacturer’s written instructions. If ordered by the Engineer, the mobile retroreflectometer shall be equipped with a flashing warning light(s), and/or warning or construction signs that meet the requirements of the New York State Manual of Uniform Traffic Control Devices (NYS MUTCD).

C. Hand Held Retroreflectometer: 30 meter geometry hand-held, portable retroreflectometer, DELTA Light and Optics, LTL 2000 retroreflectometer from Flint Trading Co. The unit shall be field calibrated on a daily basis in accordance with the manufacturer’s written instructions. No other model hand-held retroreflectometer will be allowed.

CONSTRUCTION DETAILS

A. General

Pavement markings and patterns shall be applied where shown on the Contract Documents, in accordance with the NYS MUTCD and where indicated by the Engineer.
At least 5 days prior to starting striping, the Contractor shall provide the Engineer with the epoxy pavement marking manufacturer’s written instructions for use. These instructions shall include, but not be limited to, material mixing ratios and application temperatures.

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

Pavement markings shall be applied in the direction of traffic. Striping against the direction of traffic flow will not be allowed.

When pavement markings are applied under traffic, the Contractor shall provide all necessary maintenance and protection of traffic, in accordance with the NYS MUTCD and the Engineer’s instruction.

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

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

B. Atmospheric Conditions

Epoxy reflectorized pavement markings shall be applied during conditions of dry weather and on dry pavement surfaces. At the time of installation the pavement surface temperature shall be a minimum of 5°C and the ambient temperature shall be a minimum of 5°C and rising. The Engineer will determine what are acceptable atmospheric and pavement surface conditions to produce satisfactory results.

C. Surface Preparation

The Contractor shall clean the pavement and existing pavement markings to the satisfaction of the Engineer. Surface cleaning and preparation work shall be performed only in the areas of epoxy marking application.

Removal of pavement markings, curing compounds, or other pavement surface materials and the proper collection and disposal of hazardous or non-hazardous wastes, shall be performed in accordance to §635 Cleaning and Preparation of Pavement Surfaces for Pavement Markings.

Prior to the application of new epoxy reflectorized pavement markings, the Contractor may elect to remove existing pavement markings, crack sealant, etc., that are not shown in the Contract Documents as needing removal. Such removal work shall be performed in accordance with this specification. The costs associated with this work shall be at the Contractor’s expense.
New epoxy reflectorized pavement markings may only be applied over the following types of existing pavement markings: epoxy, thermoplastic, or a single layer of traffic paint that is applied directly to the pavement surface. Any existing pavement markings that exhibit a poor bond to the pavement surface shall be removed in accordance with this specification.

At the time of pavement marking application all pavement surfaces and existing pavement markings shall be free of oil, dirt, dust, grease, salt, and other contaminants. The cost of cleaning these contaminants shall be included in the bid price of the pavement marking item.

D. Application of Epoxy Reflectorized Pavement Marking

Pavement marking operations shall not begin until the application equipment and all applicable completed surface preparation is approved by the Engineer. Epoxy reflectorized pavement markings shall be placed at the width, thickness, and pattern designated in the Contract Documents.

Epoxy reflectorized pavement markings shall be applied by simultaneously air-blasting the pavement surface, to remove loose debris; spraying the mixed two-component epoxy material at a minimum thickness of 0.38 mm; and applying reflective glass spheres onto the liquid epoxy at the minimum rate of 2.4 kg/L of epoxy. The epoxy materials shall be heated, proportioned, and mixed in accordance with the manufacturer’s recommendations.

E. Performance of Epoxy Reflectorized Pavement Markings

The Contractor shall maintain all the epoxy reflectorized pavement markings installed under this Contract (long-line and special markings). All epoxy reflectorized pavement markings installed under this Contract will be inspected and evaluated by the Engineer during installation and throughout the life of this Contract. The Engineer will evaluate all pavement markings for defects in accordance with Section G. Defective Epoxy Reflectorized Pavement Markings and Repair Methods, of this specification.

The Independent Contractor shall measure the retroreflectivity of all long-line epoxy reflectorized pavement markings installed under this Contract. Retroreflectivity shall be expressed as millicandellas/square meter/lux (mcd/m²/lx). The same Independent Contractor shall perform all of the retroreflectivity surveys required under these specifications.

The Engineer may allow the use of a hand-held retroreflectometer meeting this specification, for areas that cannot feasibly or safely be measured with the mobile retroreflectometer unit or which are short length segments that would require unnecessary and cost prohibitive mobilization of the mobile retroreflectometer. Usage of a portable retroreflectometer will be limited.

At the time of any retroreflectivity survey the epoxy reflectorized pavement markings shall be dry,
free of excess reflective glass spheres, and free of foreign contaminants. The Independent Contractor shall perform an initial retroreflectivity survey for all newly applied long-line epoxy reflectorized pavement markings, and annual retroreflectivity surveys for the identical long-line pavement marking areas during the life of this Contract (total of four yearly retroreflectivity surveys). Retroreflectivity surveys for the initial installation shall be conducted no more than 60 days after and no sooner than 14 days following application. Subsequent retroreflectivity surveys shall be conducted prior to August 15 and no sooner than 14 days after the application of new pavement markings.

The Department reserves the right to be present and to witness the Independent Contractor’s retroreflectivity surveys. The Independent Contractor shall notify the Engineer at least 48 hrs. prior to conducting a survey.

The Engineer may perform quality assurance of all pavement markings through the use of an approved retroreflectometer, by conducting nighttime visibility surveys, or by evaluating the pavement markings for other types of defects as described within this specification. The Contractor shall provide all the necessary maintenance and protection of traffic, at no additional cost to the State, if requested by the Engineer.

Once a year, the Engineer may require the Independent Contractor to perform an additional retroreflectivity survey of roadway sections that appear to be unsatisfactory as determined through nighttime visual inspections. No additional payment shall be made for such surveys.

Epoxy reflectorized pavement markings that fail to meet the minimum specified performance standards shall be repaired or replaced by the Contractor as required and in accordance with this specification.

F. Retroreflectivity Sampling and Testing.

Primary Testing: Retroreflectivity shall be measured by the mobile retroreflectometer. The unit shall continuously measure and record the retroreflectivity of each individual pavement marking line. For reporting purposes, retroreflectivity shall be the average of each 160 meter line segment for any given line type or line color.

Hand-Held Testing: Measurements shall be taken in accordance with the sampling procedure described in ASTM D 6359. The Engineer may require retroreflectivity measurements (test point measurements) at additional checkpoint areas within any measurement zone. Checkpoint areas will be located on tangent sections of the roadway. Retroreflectivity measurements with the handheld unit shall not be taken in areas of abnormally high traffic wear such as driveways, curves, intersections, etc. The reported average retroreflectivity measurement using the hand-held unit,
shall be the average retroreflectivity (mcd/m²/lx) reading of a checkpoint area as described in ASTM D 6359.

**Minimum Retroreflectivity Performance Standards.** All long-line, white and yellow epoxy reflectorized pavement markings installed under this Contract shall meet minimum average retroreflectivity performance standards. In addition to long-line pavement markings, special type epoxy reflectorized pavement markings such as letters, symbols, stopbars, crosswalk marking patterns, etc., may also be installed by the Contractor. The following retroreflectivity performance standards shall apply only to long-line pavement markings.

<table>
<thead>
<tr>
<th>Minimum Average Retroreflectivity mcd/m²/lx</th>
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<tbody>
<tr>
<td>Contract Year</td>
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<tr>
<td>First Year</td>
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<tr>
<td>Next 3 years</td>
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</tbody>
</table>

**Retroreflectivity Survey Report.** Within 30 days following the completion of each retroreflectivity survey, the Independent Contractor shall compile and summarize the survey results into a printed and formatted report. The Independent Contractor shall certify that the contents of each report meet the requirements of these specifications. The written certification shall state that the information contained in the report is complete, true, and accurate, and that the reported information represents the work performed for the epoxy reflectorized pavement markings installed under this Contract. Two certified print copies of each report and two CD Rom versions of the report, shall be submitted for each survey to each of the following: the Contractor, the Engineer, and the Materials Bureau.

The retroreflectivity report shall include the following listed information:

a. Contract Number  
b. Region, County, and Route No.  
c. Epoxy Pavement Marking: Color, Line Type (Edgeline, Centerline, or Skipline), Direction, and Plan Width  
d. Start and Stop Points using intersecting Route Nos., Street Names, or Reference Markers  
e. Average Retroreflectivity Reading (mcd/m²/lx) per 160 m survey length  
f. Name and Serial No. of Retroreflectometer Equipment  
g. Dates (mm/dd/yy) of Retroreflectivity Survey  
h. Name and Address of Independent Contractor

Average retroreflectivity measurements that fall below the minimum specified
retroreflectivity performance standards shall be highlighted or boldly identified in the report.

G. Defective Epoxy Reflectorized Pavement Markings and Repair Methods

Defective epoxy reflectorized pavement markings shall be repaired in accordance with the respective method of repair. Epoxy reflectorized pavement markings shall be considered to be defective for any of the following reasons listed below.

The Engineer will review the retroreflectivity measurements in each of the survey reports and determine areas of epoxy reflectorized pavement markings that do not meet minimum retroreflectivity standards contained within these specifications, and require corrective action.

- Insufficient epoxy film thickness, insufficient line width, non-uniform or inadequate coverage rate of reflective glass spheres, inadequate reflective glass sphere retention or embedment, excessive abrasion loss, or failure of newly applied long-line pavement markings to meet minimum average retroreflectivity standards.

These types of defective epoxy reflectorized pavement markings shall be repaired by first preparing 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 air blasting.

Repair shall be made by restriping over the cleaned surface in accordance with the requirements of these specifications.

- Uncured epoxy, or inadequate adhesion of epoxy to substrate. Uncured epoxy material fails to properly harden in accordance with this specification. Improperly cured epoxy can appear as localized areas or patches of brown, grayish or black colored epoxy. It will also remain soft and may be easily removed off the pavement surface. These areas often occur in a cyclic pattern or in longitudinal streaks, and often are not visible until several days or weeks after markings are applied.

Pavement markings shall be completely removed down to the underlying pavement surface. Removal and cleaning work shall be performed in accordance with Section 635 - Cleaning and Preparation of Pavement Surfaces.

For uncured defective epoxy pavement markings, the extent of removal shall be the defective area plus any adjacent epoxy reflectorized pavement marking material extending
one meter in any direction.

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

- **Failure of long-line pavement markings to meet minimum average retroreflectivity standards during the life of the Contract (excluding newly applied pavement markings).**

Repair shall be made by applying new epoxy reflectorized pavement markings in accordance with this specification over the existing defective epoxy reflectorized pavement markings.

The Contractor shall be required to repair defective epoxy reflectorized pavement markings in areas where the average retroreflectivity readings, within a 160m survey run, fall below the minimum specified retroreflectivity standard. If more than 4 average readings fall below the minimum standard within a 1600m survey length, the entire 1600m section shall be repaired. Newly applied epoxy reflectorized pavement markings that are reported to be defective in the initial retroreflectivity report may be accepted by the Engineer, if the retroreflectivity readings are within 90% of the specified minimum. Payment for these defective pavement markings will be reduced by 20% of the Contract unit bid price. The Contractor shall elect to either repair these defective pavement markings or accept the reduction in payment.

Defective epoxy reflectorized pavement markings shall be repaired by the Contractor within 30 days of receipt of the Independent Contractor’s report. All defective epoxy reflectorized pavement markings shall be repaired by November 30 of the year of the pertaining report. The Contractor will be assessed liquidated damages of $500 per day for any defective pavement markings that are not repaired within the 30 day time period.

Other types of defects not noted above, but determined by the Engineer to need repair, shall be repaired by the Contractor to the satisfaction of the Engineer. Epoxy reflectorized pavement markings that become defective due to snowplowing or deicing operations will be required to be repaired by the Contractor. No additional payment will be made by the State for these repairs.

Epoxy reflectorized pavement markings that become defective due to other Contract or Department maintenance work shall not be subject to warranty repair by the Contractor. Examples of such work include: pavement repairs, crack sealing operations, or Department pavement marking operations. Epoxy reflectorized pavement markings that become defective for these reasons shall be repaired by the Contractor (A.O.B.E.), however, payment shall be made by the State at 70% of the Contract unit bid price.
ITEM 91685.21XX M - EPOXY REFLECTORIZED PAVEMENT MARKINGS - 0.38 mm - THREE YEAR PERFORMANCE WARRANTY

All repairs of defective epoxy reflectorized pavement markings shall be performed to the satisfaction of the Engineer.

All related work to repair defective epoxy reflectorized pavement markings shall be performed by the Contractor at no additional cost to the State.

WARRANTY REQUIREMENTS

The Contractor shall provide the Department with a Faithful Performance Bond and a Labor and Material Bond in the full amount of all of the epoxy reflectorized pavement marking items. These bonds shall conform to the requirements of §103-04 Award and Execution of Contract, of the New York State Department of Transportation Standard Specifications, and they will be in full force and effect until the expiration of the 3 year performance warranty period, and the satisfactory completion of all repair work ordered by the Engineer. In addition, the Contractor shall keep in force the various types of insurance as required by §107 Legal Relations and Responsibilities to Public, of the New York State Department of Transportation Standard Specifications.

The Contractor shall replace defective epoxy reflectorized pavement markings in accordance with this specification and to the satisfaction of the Engineer, or the Contractor may elect to receive a reduction in payment as described within this specification. The Engineer will notify the Contractor in writing upon satisfactory completion of all work.

The Engineer will release the Contractor of his responsibility for further performance warranty work after the Contractor fulfills the requirements of these specifications, including the proper repair of defective epoxy reflectorized pavement markings.

METHOD OF MEASUREMENT

Pavement striping will be measured as the number of meters along the centerline of the pavement stripe applied, 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:

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

Measurements shall not include the number of linear meters of unmarked spaces in between broken lane lines.

Letters and symbols will be measured by each unit applied. A unit will consist of one letter or one symbol. Example: "SCHOOL" would be paid as six units. Double and triple headed arrows will be measured as a single unit, but the “X” in railroad grade crossing markings will be measured by linear meters of 100 mm stripe.
BASIS OF PAYMENT

The unit bid price shall include the cost of furnishing all labor, materials and equipment to satisfactorily complete the installation of all work and to repair defective epoxy reflectorized pavement markings. The unit bid price shall include the costs associated with furnishing all labor, materials, and equipment to perform retroreflectivity performance surveys and to provide retroreflectivity performance survey reports. The cost of maintaining and protecting traffic during the epoxy reflectorized pavement marking installation, retroreflectivity performance surveys, or repair of defective epoxy reflectorized pavement markings shall be included in the contract unit bid price.

The accepted quantities of long-line epoxy reflectorized pavement markings will be paid for at the following percentages of the contract unit bid price for all work satisfactorily completed: first year (70%), second year (10%), third year (10%), fourth and final year (10%).

Payment will be made at the contract unit price as follows:

<table>
<thead>
<tr>
<th>PAY ITEM NO.</th>
<th>ITEM</th>
<th>PAY UNIT</th>
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<tbody>
<tr>
<td>91685.2101 M</td>
<td>White Epoxy Reflectorized Pavement Stripes - 0.38 mm Three Year Performance Warranty</td>
<td>Meter</td>
</tr>
<tr>
<td>91685.2102 M</td>
<td>Yellow Epoxy Reflectorized Pavement Stripes - 0.38 mm Three Year Performance Warranty</td>
<td>Meter</td>
</tr>
<tr>
<td>91685.2103 M</td>
<td>White Epoxy Reflectorized Pavement Letters - 0.38 mm Three Year Performance Warranty</td>
<td>Each</td>
</tr>
<tr>
<td>91685.2104 M</td>
<td>White Epoxy Reflectorized Pavement Symbols - 0.38 mm Three Year Performance Warranty</td>
<td>Each</td>
</tr>
</tbody>
</table>