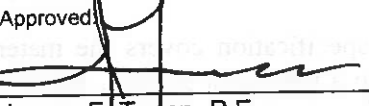


SUPERSEDED BY EB 15-031 EFFECTIVE 9/28/15		New York State Department of Transportation ENGINEERING INSTRUCTION	EI 11-017
Title: STANDARD SPECIFICATIONS – SECTION 727 PAVEMENT MARKING MATERIALS			
Target Audience: ☒ Manufacturers (18) ☒ Local Govt. (31) ☒ Agencies (32)		Approved:  James F. Tyrnan, P.E. Deputy Chief Engineer (Construction)	
☒ Surveyors (33) ☒ Consultants (34) ☒ Contractors (39)		Date <u>9-21-11</u>	

ADMINISTRATIVE INFORMATION:

- This Engineering Instruction (EI) is effective upon signature.
- This EI supersedes EIs 06-009 and 10-018.
- This revision will be incorporated into a future update of the Standard Specifications.

PURPOSE:

This EI issues a revised Standard Specification Section 727 *Pavement Marking Materials*.

TECHNICAL INFORMATION:

- This EI is being issued concurrently with EI 11-016 Standard Specifications – Section 619 *Work Zone Traffic Control* and EI 11-018 Standard Specifications – Section 729 *Temporary Traffic Control Devices*.
- This minor revision includes rewording of the basis of acceptance for temporary and interim pavement marking material.
- Temporary pavement markings are intended to be used for up to 14 days, and do not require materials certifications. The specification requires material certification upon request.
- Interim pavement markings are intended to be used for a construction season, for a maximum of one year and require material certifications.
- A requirement for compliance with AASHTO M247 *Standard Specification for Glass Beads Used in Pavement Markings* was added to §727-05 *Glass Beads for Pavement Markings*.
- The remainder of Section 727 is reprinted with only minor editorial changes.

IMPLEMENTATION:

Main Office Design Quality Assurance Bureau will insert the Standard Specification revision into contract proposals beginning with projects submitted for the letting of 01/12/12.

Engineers-in-Charge of ongoing contracts and those let prior to the inclusion of the shelf note in the contract proposal should file a copy of this EI in the contract records as documentation of the change in accordance with the Contract Administration Manual (CAM) §104-02.

TRANSMITTED MATERIALS:

This EI transmits standard specification revisions for *Pavement Marking Materials* in both Metric and USC units.

CONTACT:

Questions regarding this EI should be directed to:

John Ferry (JFerry@dot.state.ny.us) of the Office of Construction at (518) 457-6472.

Patrick Galarza (PGlarza@dot.state.ny.us) of Materials Bureau at (518) 457-4599.

PAVEMENT MARKING MATERIALS

Make the following changes to the Standard Specifications of May 4, 2006.

Page 961, **Delete** Section 727 *Pavement Marking Materials* and **Replace** it with the following:

SECTION 727 - PAVEMENT MARKING MATERIALS

727-01 EXTRUDED THERMOPLASTIC

SCOPE. This specification covers the material requirements for thermoplastic that is extruded, in a molten state, onto a pavement surface. Following a surface application of reflective beads the resultant marking is a reflectorized stripe.

MATERIAL REQUIREMENTS. Unless otherwise noted, all samples are to be prepared and tested at an ambient temperature of $23^{\circ} \pm 2^{\circ}\text{C}$.

General.

- Formulated for application at temperatures greater than 205°C .
- Show no significant breakdown or deterioration at 245°C .
- Pigment, beads and filler uniformly dispersed in the binder resin.
- Be free from all skins, dirt and foreign objects.
- Comply with the following requirements:

TABLE 727-01-1 THERMOPLASTIC PROPERTIES		
Component	% by Weight	
	White	Yellow
Binder	17.0 min	17.0 min.
Titanium Dioxide	10.0 min	---
Reflective Beads	30-40	30-40
Calcium Carbonate & Inert Fillers	43.0 max	*
Yellow Pigments	---	*
* Amount and type of yellow pigment, calcium carbonate and inert fillers at the option of the manufacturer, providing the other composition requirements are met and the yellow pigment is lead chromate free.		

Physical Properties.

A. Color. (ASTM D1535) When viewed under North Standard Daylight:

White: Approximate visual color match to Munsell Book Notation N 9.5/0.

Yellow: Approximate visual color match to Munsell Book Notation 10YR8/14.

B. Yellowness Index. (ASTM D1925 at 2° Observer angle and C Illuminate)

White thermoplastic: 0.12 maximum

C. Softening Point. (ASTM E28) Softening point: 90°C minimum.

D. Specific Gravity. Between 1.8 and 2.2 as determined by a water displacement method at 25°C .

E. Field Drying Time. At 21°C , and thickness between 3 and 5 mm: Completely solid and showing no damaging effect from traffic after 10 minutes.

PAVEMENT MARKING MATERIALS

Thermoplastic Primer.

- Specifically designed to enhance the bond of thermoplastic pavement markings to HMA and/or PCC pavements.
- Be either a one-component or two-component, cold- or hot-applied material of the type recommended by the manufacturer.
- Conform to current Federal, State and Local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC) as established by the U.S. EPA, and the NYSDEC.

PACKAGING AND SHIPPING. Shipped to the job site in strong, substantial containers, clearly marked with the following and including:

- Manufacturer's Name
- Name of Product
- Material Specification Number
- Lot/Batch Number
- Manufacture Date
- Expiration Date
- Quantity
- Two-component primer containers clearly identified as "Part A" and "Part B"
- Primers accompanied with written instructions for use

BASIS OF APPROVAL. Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by samples of each color (white and yellow) of the product and applicable glass beads in accordance with §727-05 *Glass Beads For Pavement Markings*, independent lab test results in accordance to this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and a certification that the product conforms to this specification.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Extruded Thermoplastic will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

727-02 REMOVABLE RAISED PAVEMENT MARKERS

SCOPE. This specification covers the material requirements for removable raised pavement markers for use as interim and temporary pavement markings.

MATERIAL REQUIREMENTS

General. Removable raised pavement markers shall be:

Designed as single units consisting of an acrylic plastic or another type of durable casing, containing one or two reflective faces.

Approximately square in shape.

Capable of providing daytime delineation.

Adhere to HMA or PCC surfaces using adhesives and/or methods recommended by the manufacturer.

Removable from HMA and PCC pavements, intact or in substantially large pieces, without the use of heat, solvents, grinding or blasting.

Free from dirt or any other contaminants.

Physical Properties.

A. Color. (ASTM D1535) When viewed under North Standard Daylight:

White: Approximate visual color match to Munsell Book Notation N 9.5/0

Yellow: Approximate visual color match to Munsell Book Notation 10YR8/14

PAVEMENT MARKING MATERIALS

B. Size.

1. Casing. Minimum: 100 x 100 x 19 mm.
2. Reflective Lens. Minimum area of the reflective lens: 245 mm².

C. Reflectance. Initial average reflectance values, when measured with incident light parallel to the base of the marker, at an observation angle of 0.2°.

TABLE 727-02-1 REFLECTIVE MARKER LENSES REFLECTANCE				
Color	White		Yellow	
Entrance Angle	0°	20°	0°	20°
Specific Intensity (cd/fc)	1.0	0.4	0.6	0.24

NOTES:

1. Observation Angle: The angle at the reflector between the observer's line of sight and the direction of light incident on the reflector.
2. Entrance Angle: The angle in the horizontal plane between the direction of incident light and the normal to the leading edge of reflective marker.
3. Specific Intensity: The luminous intensity (candelas) of returned light at the chosen observation and entrance angles for each Lux of illumination at the reflector on a plane perpendicular to the incident light.
4. Photometric Test Procedure: The reflective marker to be tested shall be located with the center of the reflective lens at a distance of 1.5 meters from a uniformly bright light source, having an effective diameter of 5.1 mm. The return of light shall be measured using an annular ring photocell (9.5 mm I.D. x 12.5 mm O.D.). The photocell shall be shielded to eliminate stray light. The distance from the light source center to the photocell center shall be 5.3 mm. If a test distance of other than 1.5 meters is used, the source and receiver shall be modified in the same proportion as the test distance.

BASIS OF APPROVAL. Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by samples of each color (white and yellow) of the product, independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Additional field tests will be carried out in accordance with Materials Bureau Directives.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Removable Raised Pavement Markers for Interim Pavement Markings will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Removable Raised Pavement Markers used for Temporary Pavement Markings will be accepted on the basis of the product appearing on the Approved List. Upon request, the Contractor shall provide a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

727-03 EPOXY PAINT

SCOPE. This specification covers the material requirements for epoxy pavement marking paint that is applied onto pavement, followed by a surface application of retroreflective beads for use as interim and permanent pavement markings.

MATERIAL REQUIREMENTS

General. Epoxy paint shall be:

Formulated for use as a pavement marking material and for hot-spray application at elevated temperatures.

PAVEMENT MARKING MATERIALS

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).
VOC compliant and lead chromate free.

Use organic yellow pigments, Color Index Pigment Yellow 65 (C.I. 11740) and/or 74 (C.I. 11741).

Have a consistent target value of epoxy in Part A, based on ASTM D1652. Tested on a pigment free basis and calculated as the weight per epoxy equivalent (WPE).

Have a consistent total amine value of Part B based on ASTM D2074, or an alternate test method for determining the amine value specified by the manufacturer subject to the approval of the Director, Materials Bureau.

Display no bleeding on the surface upon which the paint is applied.

Conform to current Federal, State and Local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC) as established by the U.S. EPA and the NYSDEC.

Physical Properties.

A. % Pigment - Part A. (ASTM D2371) Yellow: 23% minimum
White: 18% minimum
% TiO₂ (100% Purity) (NYS Test Method 727-20C) White: 16.5% minimum

B. % Resin -- Part A. (ASTM D2371) Yellow: 70% - 77%
White: 75% - 82%

C. Color. (ASTM D1535) When viewed under North Standard Daylight, at a 0.38 mm ± .02 mm wet film thickness with no glass beads applied:

White: Approximate visual color match to Munsell Book Notation N 9.5/0

Yellow: Approximate visual color match to Munsell Book Notation 10YR8/14 and within the following chromaticity coordinate limits when tested under ASTM E1347.

TABLE 727-03-1 CHROMATICITY COORDINATES				
Coordinate	1	2	3	4
x	0.485	0.526	0.504	0.468
y	0.426	0.472	0.481	0.450

D. Directional Reflectance. (ASTM E1347) White: 84% minimum
Yellow: 54% minimum

E. Yellowness Index. (ASTM D1925 at 2° Observer angle and C Illuminate)
White Epoxy Paint: 0.12 maximum

F. Drying Time -- Laboratory. (ASTM D711) Dry to no-pick-up time in 3 minutes maximum at an application rate of 0.38 mm ± 0.02 mm wet-film thickness and glass-sphere application rate of 2.4 kg/l.

G. Hardness. (ASTM D2240) Samples cured for 72 to 96 hours prior to testing.
Shore D Hardness: 75 - 100.

H. Infrared Spectrophotometer Analysis. (ASTM D2621) The spectrum of each component will be analyzed and maintained as a base record. Any subsequent samples taken from a Department contract must be a reasonable match to the original formulation spectrum accepted by the Materials Bureau for the Approved List.

Placement Properties. The material shall be capable of being placed using standard epoxy pavement marking equipment and have a maximum field no track time of 30 minutes when installed at 25°C.

PAVEMENT MARKING MATERIALS

PACKAGING AND SHIPPING. Shipped to the job site in strong, substantial containers, clearly marked with the following information:

- Manufacturer's Name
- Name of Product
- Material Specification Number
- Lot/Batch Number
- Date of Manufacture
- Expiration Date
- The Statement (as appropriate):
"Part A Contains Pigment and Epoxy Resin," or "Part B Contains Catalyst"
- Quantity

BASIS OF APPROVAL. Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by two 0.25 liter samples of each color (white and yellow) of Part A and one 0.25 liter of Part B for each color, independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Additional field tests will be carried out in accordance with Materials Bureau Directives.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Epoxy Paint for Permanent and/or Interim Pavement Markings will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Epoxy Paint used for Temporary Pavement Markings will be accepted on the basis of the product appearing on the Approved List. Upon request, the Contractor shall provide a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

727-04 PERMANENT PAVEMENT TAPE

SCOPE. This specification covers the material requirements for preformed pavement marking tape that is applied to the pavement for use as permanent pavement markings.

GENERAL. Permanent pavement tape shall be:

Designed to provide immediate and continuous retroreflection.

Meet all the requirements of ASTM D4505.

Composed of a mixture of plastics or polymeric materials, resins, pigments, and reflective beads that are uniformly distributed throughout the thickness of the material.

Have a layer of reflective beads bonded to, or embedded in the top surface.

Pre-coated, on its bottom side, with a pressure-sensitive adhesive for adherence to HMA or PCC surfaces.

Of the specified dimension and shape with clean-cut, well-defined edges, of good appearance, and free of cracks or other defects.

Weather resistant and through normal traffic wear shall show no appreciable fading, lifting or shrinkage.

Capable of molding itself to the contours, breaks and faults of HMA or PCC surfaces.

Show no significant tearing, rollback, lifting or other signs of poor adhesion.

Free from dirt and any other contaminants.

MATERIAL REQUIREMENTS. Unless otherwise noted, all samples are to be prepared and tested at an ambient temperature of $25^{\circ} \pm 2^{\circ}\text{C}$.

PAVEMENT MARKING MATERIALS

A. Color. (ASTM D1535) When viewed under North Standard Daylight:

White: Approximate visual color match to Munsell Book Notation N 9.5/0

Yellow: Approximate visual color match to Munsell Book Notation 10YR8/14

B. Thickness. Preformed pavement marking tape shall be:

Uniform Cross Section: 1.5 mm minimum thickness

Patterned (Variable Cross Section): 0.5 mm minimum thickness at the thinnest portions and 1.5 mm minimum thickness at the thickest portions.

The patterned top surface shall have approximately 50% of the surface area raised, and its design shall provide immediate and continuing retroreflection.

C. Tensile Strength. (ASTM D638) 275 kPa minimum

Test specimens shall be Type II prepared by die cutting with Die C as specified in ASTM D412 Test Method A. The testing machine shall operate at a speed of 5 mm per minute. For calculating the tensile strength of patterned type material, the thickness measurements shall be taken in the thinnest portions of the cross sectional area.

D. Elongation. (ASTM D638) When tested in accordance with the conditions as specified for Tensile Strength: 15% minimum elongation

Primer. Primer shall be recommended by the manufacturer of the permanent tape and be compatible with the marking and surface the marking is being applied to.

Specifically designed to enhance the bond of the permanent tape to HMA and/or PCC pavements. Conform to current Federal, State and Local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC) as established by the U.S. EPA and the NYSDEC.

PACKAGING AND SHIPPING. Shipped to the job site in strong, substantial containers, clearly marked with the following and including:

- Manufacturer's Name
- Name of Product
- Material Specification Number
- Lot/Batch Number
- Manufacture Date
- Quantity
- Primers accompanied with written instructions for use
- Expiration Date

BASIS OF APPROVAL. Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by samples of each color (white and yellow) of the product, independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Additional laboratory analysis and field tests will be carried out in accordance with Materials Bureau Directives.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Permanent Pavement Tape and primer will be accepted on the basis of the products appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Permanent Pavement Tape and primer used for Temporary Pavement Markings will be accepted on the basis of the products appearing on the Approved List. Upon request, the Contractor shall provide a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

PAVEMENT MARKING MATERIALS

727-05 GLASS BEADS FOR PAVEMENT MARKINGS

SCOPE. This specification covers the material requirements for retroreflective beads applied on top of thermoplastic, epoxy or traffic paint for use as pavement markings.

MATERIAL REQUIREMENTS. Glass beads for pavement markings shall meet the requirements of AASHTO M247 and shall be:

Composed of glass that is highly resistant to traffic wear and to the effects of weathering.

Colorless, clean, transparent, free from milkiness or excessive air bubbles, and essentially free from surface scarring or scratching.

Silica content (ASTM C169): 60% minimum.

Refractive index: 1.50 when tested by the liquid immersion method at 25°C.

Show no tendency to absorb moisture in storage and shall remain free of clusters and hard lumps.

Flow freely from the dispensing equipment at any time when surface and atmospheric conditions are satisfactory for painting.

A. Sphericity. (ASTM D1155 Procedure A) Spherical in shape - 70% minimum true spheres.

Wet/Night Visibility Beads will be tested for roundness according to the procedural directives of the Materials Bureau.

B. Gradation. (ASTM D1214).

TABLE 727-05-1 GLASS SPHERE GRADATION (Standard Bead)				
Percent Passing by Weight				
Marking Type	Sieve Size			
	850µm	600 µm	300 µm	180µm
Epoxy	100	80-95	9-42	0-10
Traffic Paint	100	80-95	9-42	0-10
Thermoplastic	100	79-95	15-60	0-15

TABLE 727-05-2 GLASS SPHERE GRADATION (Wet/Night Visibility Bead)						
Percent Passing by Weight						
Marking Type	Sieve Size					
	2.0 mm	1.70 mm	1.4 mm	1.18 mm	1.00	850µm
Epoxy Wet/Night Reflective	100	95-100	75-95	10-47	0-7	0-2

C. Coating.

TABLE 727-05-3 GLASS SPHERE COATINGS	
Marking Type	Coating Type
Epoxy Wet/Night Reflective	Silane Type adherence coating designed to interact with and adhere to epoxy pavement markings.
Epoxy (Standard Bead)	Moisture-resistant coating or a dual purpose type coating (moisture-resistant and adherence).
Traffic Paint	
Thermoplastic (Drop on)	

PAVEMENT MARKING MATERIALS

D. Moisture Resistance. AASHTO M 247 Section 5.3.

PACKAGING AND SHIPPING. Shipped to the job site in waterproof plastic lined burlap or plastic lined paper bags with the following information clearly marked on the packages:

- Manufacturer's Name
- Name of Product
- Size/Type/Coating
- Material Specification Number
- Lot/Batch Number
- Manufacture Date
- Quantity/Weight of Material

BASIS OF APPROVAL. Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by one 23 kg bag sample of the product, independent lab test results in accordance with this specification and certification that the product conforms to this specification.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Glass Beads for Pavement Markings will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Glass Beads for Pavement Markings used for Temporary Pavement Markings will be accepted on the basis of the product appearing on the Approved List. Upon request, the Contractor shall provide a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

727-06 REMOVABLE PAVEMENT TAPE

SCOPE. This specification covers the material requirements for removable pavement marking tape and masking tape for use as interim and temporary pavement markings.

MATERIAL REQUIREMENTS.

General. Removable pavement tape shall be:

Composed of a mixture of plastics or polymeric materials, resins, and pigments.

Have on its bottom side, a pre-applied, pressure-sensitive adhesive for adherence to HMA or PCC surfaces.

Of the specified dimension and shape with clean-cut, well defined-edges, of good appearance, and free of cracks or other defects.

Weather resistant and through normal traffic wear shall show no appreciable fading, lifting or shrinkage.

Capable of molding itself to the contours, breaks and faults of HMA or PCC surfaces.

Show no significant tearing, rollback, lifting or other signs of poor adhesion.

Removable from HMA and PCC pavements, intact or in substantially large pieces, without the use of heat, solvents, grinding or blasting, and leaving minimal permanent marks, scars or damage to the pavement surface after removal.

Be free from dirt and any other contaminants.

Reflective Tape.

Designed to provide immediate and continuous retroreflection.

Composed of a mixture of plastics or polymeric materials, resins, pigments, and reflective beads that are uniformly distributed throughout the thickness of the material.

Have a layer of reflective beads bonded to, or embedded in the top surface.

PAVEMENT MARKING MATERIALS

Meet the following requirements:

A. Color: (ASTM D1535) When viewed under North Standard Daylight:

White: Approximate visual color match to Munsell Book Notation N 9.5/0

Yellow: Approximate visual color match to Munsell Book Notation 10YR 8/14 and be within the following chromaticity coordinate limits when tested under ASTM E1347.

TABLE 727-06-1 CHROMATICITY COORDINATES				
Coordinate	1	2	3	4
x	0.485	0.526	0.504	0.468
y	0.426	0.472	0.481	0.450

B. Reflectance:

TABLE 727-06-2 PREFORMED TAPE REFLECTANCE REQUIREMENTS				
Color	White		Yellow	
Observation Angle	0.2°	0.5°	0.2°	0.5°
Specific Luminance (mcd/m ² /lx)	1770	1270	1310	810

Masking Tape. Masking tape shall be:

Specifically designed for use to temporarily cover existing pavement markings.

Consist of durable, nonreflective, pliant polymer tape on a reinforced, conformable backing, pre-coated with a pressure-sensitive adhesive.

Capable of adhering to existing pavement markings, asphalt pavement and Portland cement concrete pavement without the use of heat, solvents, additional adhesives or other means.

Be substantially similar in color to the pavement surface with a flat matte finish and textured, skid resistant surface.

BASIS OF APPROVAL. Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by samples of each color (white, yellow, black/grey) of the product, independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Additional laboratory analysis and field tests will be carried out in accordance with Materials Bureau Directives.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Removable Pavement Tape used for Interim Pavement Markings will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Removable Pavement Tape used for Temporary Pavement Markings will be accepted on the basis of the product appearing on the Approved List. Upon request, the Contractor shall provide a material certification that the product is the same as the one appearing material on the Approved List and that it conforms to this specification.

727-07 REMOVABLE WET-NIGHT REFLECTIVE TAPE

SCOPE. This specification covers the material requirements for removable wet-night reflective tape for use as interim and temporary pavement markings.

PAVEMENT MARKING MATERIALS

MATERIAL REQUIREMENTS.

General. Removable Wet-Night reflective tape shall be:

Designed to provide immediate and continuous retroreflection in day and night as well as dry and wet conditions.

Composed of a mixture of durable plastics or polymeric materials, resins, pigments, and reflective beads that are uniformly distributed throughout the thickness of the material.

Pre-coated, on its bottom side, with a pressure-sensitive adhesive.

Capable of adhering to existing pavement markings, asphalt pavement and Portland cement concrete pavement without the use of heat, solvents, additional adhesives or other means.

Of the specified dimension and shape with clean-cut, well-defined edges, of good appearance, and free of cracks or other defects.

Weather resistant and through normal traffic wear shall show no appreciable fading, lifting or shrinkage.

Capable of molding itself to the contours, breaks and faults of HMA or PCC surfaces.

Show no significant tearing, rollback, lifting or other signs of poor adhesion.

Removable from HMA and PCC pavements, intact or in substantially large pieces, without the use of heat, solvents, grinding or blasting, and leaving minimal permanent marks, scars or damage to the pavement surface after removal.

Have a layer of reflective beads bonded to, or embedded in the top surface.

Free from dirt and any other contaminants.

Meet the following requirements:

Physical Properties.

A. Color: (ASTM D1535) When viewed under North Standard Daylight:

White: Approximate visual color match to Munsell Book Notation N 9.5/0 and be within the following daytime chromaticity coordinates (dry) when tested under ASTM E1347.

TABLE 727-07-1 WHITE CHROMATICITY COORDINATES				
Coordinate	1	2	3	4
x	0.355	0.305	0.285	0.335
y	0.355	0.305	0.325	0.375

Yellow: Approximate visual color match to Munsell Book Notation 10YR 8/14 and be within the following daytime chromaticity coordinates (dry) when tested under ASTM E1347.

TABLE 727-07-2 YELLOW CHROMATICITY COORDINATES				
Coordinate	1	2	3	4
x	0.560	0.460	0.420	0.490
y	0.440	0.400	0.440	0.510

B. Retroreflectivity. Wet: ASTM E2176 and ASTM E2177
Dry: ASTM E1710

TABLE 727-07-3 MINIMUM INITIAL RETROREFLECTANCE				
Entrance Angle: 88.76° Observation Angle: 1.05°				
Color	White		Yellow	
Condition	Dry	Wet	Dry	Wet
Retroreflectance [mcd/m ² /lx]	500	250	300	200

PAVEMENT MARKING MATERIALS

BASIS OF APPROVAL. Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by samples of each color (white and yellow) of the product, independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Additional laboratory analysis and field tests will be carried out in accordance with Materials Bureau Directives.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Removable Wet-Night Reflective Tape used for Interim Pavement Markings will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Removable Wet-Night Reflective Tape used for Temporary Pavement Markings will be accepted on the basis of the product appearing on the Approved List. Upon request, the Contractor shall provide a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

727-08 PERMANENT WET-NIGHT REFLECTIVE TAPE

SCOPE. This specification covers the material requirements for permanent wet-night pavement marking tape for use as permanent pavement markings.

MATERIAL REQUIREMENTS. Unless otherwise noted, all samples are to be prepared and tested at an ambient temperature of $23^{\circ} \pm 2^{\circ}\text{C}$.

General. Permanent wet-night reflective tape shall be:

Designed to provide immediate and continuous retroreflection in day and night as well as dry and wet conditions.

Composed of a mixture of plastics or polymeric materials, resins, pigments, and reflective beads that are uniformly distributed throughout the thickness of the material.

Have a layer of reflective beads bonded to, or embedded in the top surface.

Pre-coated, on its bottom side, with a pressure-sensitive adhesive for adherence to HMA or PCC surfaces.

Of the specified dimension and shape with clean-cut, well-defined edges, of good appearance, and free of cracks or other defects.

Weather resistant and through normal traffic wear shall show no appreciable fading, lifting or shrinkage.

Capable of molding itself to the contours, breaks and faults of HMA or PCC surfaces.

Show no significant tearing, rollback, lifting or other signs of poor adhesion.

Free from dirt and any other contaminants.

Physical Properties.

A. Color: (ASTM D1535) When viewed under North Standard Daylight:

White: Approximate visual color match to Munsell Book Notation N 9.5/0 and be within the following daytime chromaticity coordinates (dry) when tested under ASTM E1347.

TABLE 727-08-1 WHITE CHROMATICITY COORDINATES				
Coordinate	1	2	3	4
x	0.355	0.305	0.285	0.335
y	0.355	0.305	0.325	0.375

Yellow: Approximate visual color match to Munsell Book Notation 10YR 8/14 and be within the following daytime chromaticity coordinates (dry) when tested under ASTM E1347.

PAVEMENT MARKING MATERIALS

TABLE 727-08-2 YELLOW CHROMATICITY COORDINATES				
Coordinate	1	2	3	4
x	0.560	0.460	0.420	0.490
y	0.440	0.400	0.440	0.510

B. Retroreflectivity.

Wet: ASTM E2176 and ASTM E2177
Dry: ASTM E1710

TABLE 727-08-3 MINIMUM INITIAL RETROREFLECTANCE		
Entrance Angle: 88.76° Observation Angle: 1.05°		
Color	White	Yellow
Retroreflectance (mcd/m ² /lx)	750	450

C. Thickness.

Uniform Cross Section: 1.5 mm minimum thickness

Patterned (Variable Cross Section): 0.5 mm minimum thickness at the thinnest portions and 1.5 mm minimum thickness at the thickest portions.

The patterned top surface shall have approximately 50% of the surface area raised, and its design shall provide immediate and continuing retroreflection.

D. Friction Resistance. (ASTM E303) Friction resistance: 45 BPN minimum.

E. Tensile Strength. (ASTM D638) Tensile strength: 0.275 MPa minimum

Test specimens shall be Type MII prepared by die cutting with Die C as specified in ASTM D412, Test Method A. The testing machine shall operate at a speed of 5 mm per minute. For calculating the tensile strength of patterned type material, the thickness measurements shall be taken in the thinnest portions of the cross sectional area.

F. Elongation. (ASTM D638) 15% minimum elongation when tested in accordance with the conditions as specified for Tensile Strength.

Primer. Primer shall be:

Be recommended by the manufacturer of the preformed pavement marking and be compatible with the marking and surface the marking is being applied to.

Specifically designed to enhance the bond of the preformed pavement markings to HMA and/or PCC pavements.

Conform to current Federal, State and Local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC) as established by the U.S. EPA and the NYSDEC.

PACKAGING AND SHIPPING. Shipped to the job site in strong, substantial containers, clearly marked with the following and including:

- Manufacturer's Name
- Name of Product
- Material Specification Number
- Lot/Batch Number
- Manufacture Date
- Quantity
- Primers accompanied with written instructions for use
- Expiration Date

PAVEMENT MARKING MATERIALS

BASIS OF APPROVAL. Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by samples of each color (white and yellow) of the product, independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Additional laboratory analysis and field tests will be carried out in accordance with Materials Bureau Directives.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Permanent Wet Night Reflective Tape and primer will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Permanent Wet-Night Reflective Tape and primer used for Temporary Pavement Markings will be accepted on the basis of the product appearing on the Approved List. Upon request, the Contractor shall provide a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

727-09 TRAFFIC PAINT

SCOPE. This specification covers the material requirements for waterborne and solventborne paints that are applied onto pavement, followed by a surface application of retroreflective beads for use as temporary, interim and permanent pavement markings

MATERIAL REQUIREMENTS.

General. Traffic paint shall be:

Formulated for use as a pavement marking material.

Be VOC compliant and lead chromate free.

Yellow paints must use organic yellow pigments Color Index Pigment Yellow 65 (C.I. 11740) and/or 74 (C.I. 11741).

Display no bleeding on the surface upon which the paint is applied.

Conform to current Federal, State and Local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC) as established by the U.S. EPA, and the NYSDEC.

Physical Properties.

Traffic paint for permanent and Interim Pavement Markings shall conform to the requirements of paragraphs A through L below. Traffic paint for Temporary Pavement Markings shall conform to the following paragraphs: B. *Color*; C. *Directional Reflectance*; D. *Yellowness Index*; E. *Drying Time*; F. *Viscosity*; and G. *Dry Opacity*.

A. Composition.

% Pigment. (ASTM D3723) 58.0% – 62.0%

% Total Solids. (ASTM D3723) 76.0 % minimum

% Vehicle Non-Volatile. (ASTM D3723) 43.0 % minimum

The manufacturers certified organic yellow pigment content shall be used to determine the final laboratory test results for: total pigment (%), and for nonvolatile vehicle (%). The Department reserves the right to validate the manufacturers "certified" organic yellow pigment content through outside, independent laboratory testing.

B. Color. (ASTM D1535) When viewed under North Standard Daylight at a 0.38 mm ± 0.03 mm wet film thickness with no glass beads applied:

White: Approximate visual color match to Munsell Book Notation N 9.5/0.

Yellow: Approximate visual color match to Munsell Book Notation 10YR 8/14 and within the following chromaticity coordinate limits when tested under ASTM E1347.

PAVEMENT MARKING MATERIALS

TABLE 727-09-1 CHROMATICITY COORDINATES				
Coordinate	1	2	3	4
x	0.485	0.517	0.492	0.468
y	0.426	0.462	0.471	0.450

C. Directional Reflectance (ASTM E1347)

White: 84% minimum
Yellow: 54% minimum

D. Yellowness Index. (ASTM D1925 at 2° Observer angle and C Illuminate)
White Traffic Paint: 0.12 maximum.

E. Viscosity. (ASTM D562 Procedures B) 75 – 95 Kneb Units at 25°C

F. Dry Opacity. (ASTM D2805) 0.95 minimum contrast ratio
Application at 90 mm wide, wet-film thickness of 0.13 mm to white and black contrast panels matching Lenta Form 5C or equivalent. Dry time of 1 hour minimum.

G. Abrasion Resistance. (ASTM D4060) Four plate samples for each lot will be prepared for testing on the Taber Abaser. The paint will be sprayed on steel plates, or applied by other suitable means so as to ensure a nominal 0.38 mm wet film thickness on each plate. Plates will be cured at standard laboratory temperature and humidity for 2 to 24 hours. The paint abrasion plates will be cleaned, dressed, and baked at 105° C for 18 hours. After baking, the plates will be allowed to cool in a desiccator for one hour and then weighed. The plates will be abraded for 1000 cycles on the Taber Abraser. The Taber Abraser will be operated with 500 gram weights and CS 10 wheels on the machine.

After abrading, the samples will be cleaned with a soft brush, placed in a desiccator for one hour and weighed again. The average weight loss for the four plates shall not exceed 50 milligrams.

H. Flexibility. (Federal Specification TT-P-1952B Section 4.5.4) No cracking or flaking visible. Determine flexibility in accordance with Method B of ASTM D522.

I. Freeze-Thaw Stability. (Federal Specification TT-P-1952b, Section 4.5.7)
No coagulation or change in consistency (D562) greater than 15 Kneb Units.

J. Heat Stability. (Federal Specification TT-P-1952b, Section 4.5.8) Waterborne only. No coagulation, discoloration or change in consistency (D562) greater than 15 Kneb Units when tested in an oven at 49° ± 1°C.

K. Infrared Spectrophotometer Analysis.

Waterborne: (ASTM D3168) Solventborne: (ASTM D2621)

The spectrum of the paint will be analyzed and maintained as a base record. Any subsequent samples taken from a Department contract must be a reasonable match to the original formulation spectrum accepted by the Materials Bureau for the Approved List.

Placement Properties.

The material shall be placed using standard traffic paint application equipment and have a maximum field no track time of 3 minutes when installed at 25°C.

PAVEMENT MARKING MATERIALS

PACKAGING AND SHIPPING. Shipped to the job site in strong, substantial containers. Individual containers plainly marked with the following information:

- Manufacturer's Name
- Name of Product
- Material Specification Number
- Lot/Batch Number
- Test Number
- Manufacture Date
- Expiration Date
- Quantity

BASIS OF APPROVAL. Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by eight 0.5 liter samples of each color (white and yellow) of the product, independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Additional field tests will be carried out in accordance with Materials Bureau Directives.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Traffic Paint for permanent and Interim Pavement Markings will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Traffic Paint used for Temporary Pavement Markings need not appear on the Approved List. Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

PAVEMENT MARKING MATERIALS

Make the following changes to the Standard Specifications of May 1, 2008.
Page 1006, **Delete** Section 727 *Pavement Marking Materials* and **Replace** it with the following:

SECTION 727 - PAVEMENT MARKING MATERIALS

727-01 EXTRUDED THERMOPLASTIC

SCOPE. This specification covers the material requirements for thermoplastic that is extruded, in a molten state, onto a pavement surface. Following a surface application of reflective beads the resultant marking is a reflectorized stripe.

MATERIAL REQUIREMENTS. Unless otherwise noted, all samples are to be prepared and tested at an ambient temperature of $73^{\circ}\text{F} \pm 3^{\circ}\text{F}$.

General.

- Formulated for application at temperatures greater than 400°F .
- Show no significant breakdown or deterioration at 475°F .
- Pigment, beads and filler uniformly dispersed in the binder resin.
- Be free from all skins, dirt and foreign objects.
- Comply with the following requirements:

TABLE 727-01-1 THERMOPLASTIC PROPERTIES		
Component	% by Weight	
	White	Yellow
Binder	17.0 min	17.0 min.
Titanium Dioxide	10.0 min	---
Reflective Beads	30-40	30-40
Calcium Carbonate & Inert Fillers	43.0 max	*
Yellow Pigments	---	*
* Amount and type of yellow pigment, calcium carbonate and inert fillers at the option of the manufacturer, providing the other composition requirements are met and the yellow pigment is lead chromate free.		

Physical Properties.

A. Color. (ASTM D1535) When viewed under North Standard Daylight:

White: Approximate visual color match to Munsell Book Notation N 9.5/0.

Yellow: Approximate visual color match to Munsell Book Notation 10YR8/14.

B. Yellowness Index. (ASTM D1925 at 2° Observer angle and C Illuminate)
White thermoplastic: 0.12 maximum

C. Softening Point. (ASTM E28) Softening point: 194°F minimum.

D. Specific Gravity. Between 1.8 and 2.2 as determined by a water displacement method at 77°F .

E. Field Drying Time. At 70°F , and thickness between 1/8 inch and 3/16 inch: Completely solid and showing no damaging effect from traffic after 10 minutes.

PAVEMENT MARKING MATERIALS

Thermoplastic Primer.

- Specifically designed to enhance the bond of thermoplastic pavement markings to HMA and/or PCC pavements.
- Be either a one-component or two-component, cold- or hot-applied material of the type recommended by the manufacturer.
- Conform to current Federal, State and Local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC) as established by the U.S. EPA, and the NYSDEC.

PACKAGING AND SHIPPING. Shipped to the job site in strong, substantial containers, clearly marked with the following and including:

- Manufacturer's Name
- Name of Product
- Material Specification Number
- Lot/Batch Number
- Manufacture Date
- Expiration Date
- Quantity
- Two-component primer containers clearly identified as "Part A" and "Part B"
- Primers accompanied with written instructions for use

BASIS OF APPROVAL. Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by samples of each color (white and yellow) of the product and applicable glass beads in accordance with §727-05 *Glass Beads For Pavement Markings*, independent lab test results in accordance to this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and a certification that the product conforms to this specification.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Extruded Thermoplastic will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

727-02 REMOVABLE RAISED PAVEMENT MARKERS

SCOPE. This specification covers the material requirements for removable raised pavement markers for use as interim and temporary pavement markings.

MATERIAL REQUIREMENTS

General. Removable raised pavement markers shall be:

Designed as single units consisting of an acrylic plastic or another type of durable casing, containing one or two reflective faces.

Approximately square in shape.

Capable of providing daytime delineation.

Adhere to HMA or PCC surfaces using adhesives and/or methods recommended by the manufacturer.

Removable from HMA and PCC pavements, intact or in substantially large pieces, without the use of heat, solvents, grinding or blasting.

Free from dirt or any other contaminants.

Physical Properties.

A. Color. (ASTM D1535) When viewed under North Standard Daylight:

White: Approximate visual color match to Munsell Book Notation N 9.5/0

Yellow: Approximate visual color match to Munsell Book Notation 10YR8/14