

Extruded Thermoplastic Reflectorized Pavement Markings

DESCRIPTION. Under this work, the Contractor shall furnish and apply extruded thermoplastic reflectorized pavement markings at the location and in accordance with patterns indicated on the plans or as ordered by the Engineer, and in conformance with the MUTCD and these specifications.

The thermoplastic pavement marking compound shall be extruded in a molten state onto the pavement surface. Following surface application of glass beads and upon cooling to normal pavement temperatures, the resultant marking shall be an adherent reflectorized stripe, letter or symbol of the specified thickness and width that is capable of resisting deformation by traffic.

MATERIALS.

Extruded Thermoplastic. Extruded thermoplastic shall be capable of application on new and existing asphalt and Portland cement concrete surfaces meet the requirements of AASHTO M249 and shall:

- Not contain 0.1% or more of any chemical listed by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP), or regulated by the US Occupational Safety and Health Administration (OSHA) as a carcinogen.
- Conform to current Federal, State and Local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC).
- Be in suitable, well-sealed packaging that is original and unopened. Shipping documents and packaging shall have identification numbers or batch dates for confirmation of when products were manufactured, brand name, name of manufacturer, lot or batch number, temperature range for storage, expiration date, the quantity contained and Include Material Safety Data Sheets. This information shall be made available for inspection at any time.
- Be stored in accordance with the manufacturer's instructions and manufacturers' requirements for shelf life and storage conditions.
- Be clearly labeled and in a dry and clean condition prior to use.
- Provide a surface friction of 45 BPN min.
- Be colored yellow or white in conformance with the latest edition of the Manual of Uniform Traffic Control Devices (MUTCD) as specified on provided Work Orders or Plans.
- Formulated for application at temperatures between 400°F and 475 °F.
- Show no significant breakdown or deterioration at 475°F.
- Be free from all skins, dirt and foreign objects.
- Comply with the following requirements:

Component	% by Weight	
	White	Yellow
Binder Content	20.0 min	20.0 min.
TiO ₂ Pigment Content	10.0 min	Not Applicable
Glass Beads Content	30-40	30-40
Inert Fillers	*43 max	*

* 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.

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Physical Properties of Extruded Thermoplastic.

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.

Glass Beads. Glass beads applied to the surface of thermoplastic pavement markings shall meet the requirements of AASHTO M247-11 and NYSDOT Standard Specifications Section 727-05.

Thermoplastic Primer. All Portland cement pavement surfaces shall be primed. The primer shall be either a one-component or a two-component, cold or hot applied material of the type recommended by the manufacturer of the thermoplastic pavement marking material. At least five working days prior to the start of thermoplastic application, the Contractor shall provide the Engineer with the manufacturer's written instructions for primer application. The application of the primer shall be performed in accordance with the manufacturer's written recommendations which shall include the method of application, the application rate, and the drying time.

APPROVED THERMOPLASTIC MATERIALS. Extruded Thermoplastic Pavement Marking Materials appearing on NYSDOT's Approved List under Section 727-01 with a Manufacturer's certification that the product meets the requirements of this specification (e.g. binder 20.0 % by weight minimum rather than NYSDOT's 17% minimum), or a Product approved equal as determined by the Engineer, are deemed acceptable for use. For NYSDOT's most updated approve materials list, please see: <https://www.dot.ny.gov/divisions/engineering/technical-services/technical-services-repository/alme/pav.html>.

CONSTRUCTION DETAILS.

General. All pavement markings and patterns shall be placed as shown on the Contract or Work Order documents and in accordance with the MUTCD.

Before any pavement marking work is begun, a schedule of operations shall be submitted for approval by the Engineer or his/her authorized representative. At least five (5) days prior to starting striping, the Contractor shall provide the Engineer with the preformed thermoplastic manufacturer's written instructions for use. These instructions shall include, but not be limited to, recommended material mixing ratios and application temperatures.

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Inspectors have the right to shut down work if any required documentation, safety requirements or performance requirements are not met.

Material Temperatures. Extruded thermoplastic shall be applied at a temperature between 400°F and 475 °F per manufacturer requirements as measured at the extrusion shoe(s). No extruded thermoplastic shall be placed until a temperature within this range is attained and maintained at the extrusion shoe(s) and use of ribbon method is not allowed.

Work Zone Traffic Control. 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. Installation against the direction of traffic flow shall not be allowed.

Mis-placed and tracked material. The Contractor shall be responsible for removing, to the satisfaction of the Engineer, all tracking marks, spilled preformed thermoplastic, and preformed thermoplastic markings applied in unauthorized areas.

Atmospheric Conditions. Thermoplastic 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 55°F and the ambient temperatures shall be a minimum of 50°F and rising.

Surface Preparation. The Contractor shall clean the pavement and existing durable markings to the satisfaction of the Engineer. At the time of application, all pavement surfaces and existing durable markings shall be free of oil, dirt, dust, grease and similar foreign materials. A high volume air blower shall be used to clear dust and debris from the surface for all applications to be included in the unit cost for this item - except where water blasting for surface preparation is specifically called out on the Work Order as a payment item.

Extruded Thermoplastic Bond Strength. Bonding between extruded thermoplastic and the pavement shall be randomly tested using a lift-off tester according to ASTM 4796 and D7234.

Thermoplastic Application Equipment. Thermoplastic application equipment shall be approved by the Engineer prior to the start of work.

Thermoplastic material shall be applied to the pavement surface by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, suitable equipment for maintaining the temperature and controlling the flow of material.

For heating the thermoplastic composition, the application equipment shall include a melting kettle(s) of such capacity as to allow for continuous marking operations. The melting kettle(s) may be mounted on a separate "supply" vehicle or included as part of the mobile application equipment. The kettle(s) shall be capable of heating the thermoplastic composition temperatures between 400 °F and 475 °F. The heating mechanism shall be by means of a thermostatically controlled heat transfer medium. Heating of the composition by direct flame will not be allowed. Material temperature gauges shall be visible at both ends of the kettle(s) and at the extrusion shoe(s).

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Application equipment shall be constructed to provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe(s) shall be so constructed as to prevent accumulation and clogging. All parts of the equipment which come into contact with the material shall be so constructed so as to be easily accessible and exposable for cleaning and maintenance. The equipment shall be constructed so that all mixing and conveying parts up to and including the extrusion shoe(s), maintain the material at the required plastic temperature.

The application equipment shall be so constructed as to insure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off stripe ends squarely and shall provide a method of applying "skip" lines. The equipment shall be capable of applying varying widths of traffic markings.

The applicator shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow. The bead dispenser shall be automatically operated in such a manner that it will only dispense beads while the composition is being applied. Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. Applicators shall be equipped and constructed in such a manner as to satisfy the requirements of the

Mobile Application Equipment. The mobile applicator shall be defined as a truck mounted, self-contained pavement marking machine that applies thermoplastic by the extrusion method. The unit shall be equipped to apply the thermoplastic material at the widths and thicknesses specified herein. The mobile unit shall be capable of operating continuously and of installing a minimum of 20,000 feet of longitudinal markings in an 8-hour day.

The mobile unit shall be equipped with a melting kettle(s) or materials storage reservoir(s) of such capacity as to allow for continuous marking operations.

The mobile unit shall be equipped with an extrusion shoe(s), and shall be capable of marking edgeline and centerline stripes. The extrusion shoe(s) shall be closed, heat jacketed or suitably insulated unit; shall hold the molten thermoplastic at a temperature greater than 400°F; and shall be capable of extruding a line between 3 to 8 inches in width; and at a thickness of not less than 1/8 inch nor more than 3/16 inch, and of generally uniform cross section. Material temperature gauges shall be affixed or incorporated in the extrusion shoe in such a manner as to be visible, and capable of monitoring the composition temperature throughout the marking operation.

The mobile unit shall be equipped with an electronic and programmable line pattern control system, or mechanical control system, so as to be capable of applying skip or solid lines in any sequence, and through any extrusion shoe in any cycle length.

Portable Application Equipment. The portable applicator shall be defined as hand operated equipment, specifically designed for placing thermoplastic installations such as crosswalks; stop bars; legends; arrows; and short lengths of lane, edge, and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. It is intended that the portable applicator will be loaded with hot thermoplastic composition from the melting kettle(s). The portable applicator shall be equipped with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten

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thermoplastic at temperatures greater than 400°F, of extruding a line of from 3 to 8 inches in width, and in thickness of not less than 1/8 inch nor more than 3/16 inch and of generally uniform cross-section. Material temperature gauges shall be affixed or incorporated in the extrusion shoe in such a manner as to be visible, and capable of monitoring the composition temperature throughout the marking operation.

Application of Thermoplastic Reflectorized Pavement Markings. All special markings, cross walks, stop bars, legends, arrows, and similar patterns shall be placed with a portable applicator. Unless otherwise specified in the contract documents all center line, skip line, edge line and other longitudinal type markings may be applied with either a portable or a mobile applicator.

When the surface preparation work has been completed, if applicable, the bituminous and/or concrete pavement surface shall be primed and with a primer in accordance with the manufacturer's written instructions. Primer shall not be required on new bituminous pavement surfaces that are completed within the same calendar year as the thermoplastic marking application. The primer shall be spray applied onto the pavement surface and allowed to dry according to the manufacturer's written instructions. Pavement surfaces that are primed and not striped with thermoplastic within the required drying time or within the same work day shall be re-primed.

After the primer has dried, the thermoplastic shall be applied at composition temperatures no lower than 400°F at the point of deposition. Immediately after installation of the thermoplastic, drop-on reflective glass spheres shall be mechanically applied such that the spheres are held by and embedded in the surface of the molten composition.

Defective Thermoplastic Pavement Markings. Thermoplastic reflectorized pavement markings, which after application and setting 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 glass bead coverage or inadequate glass bead retention.
Repair Method. Prepare the surface of the defective thermoplastic marking or the surface so the application surface shall be free of oil, dirt, dust, grease and similar foreign materials. Repair shall be made by removing and replacing the marking or by melting the surface and evenly reapplying glass beads with a shaker.
2. Uncured or discolored thermoplastic and/or insufficient bond to pavement surface or existing durable marking.
Repair Method. The defective thermoplastic marking shall be completely removed and cleaned to the underlying pavement surface and re-applied in accordance with the requirements of this specification.

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 thermoplastic reflectorized pavement markings shall be performed at the Contractor's expense.

Personal Protective Equipment. Follow all exposure, respiratory and personal protective equipment controls, handling and safety precautions and spill and disposal procedures as identified by s safety data sheets (SDS), labels and other manufacturer's recommendations for the products used.

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WORK ZONE TRAFFIC CONTROL (WZTC). The Contractor is responsible for ensuring appropriate WZTC in compliance with the MUTCD appropriate for the dry time of the selected material applied. The Contractor is responsible to ensure adequate WZTC to prevent those walking, skating, bicycling, and driving from coming into contact with applied material that is still capable of being tracked. The Contractor shall be liable for such tracking and property damage should it occur.

METHOD OF MEASUREMENT. Pavement striping will be measured by linear foot along the centerline of the pavement stripe, and will be based on a 4 inch wide stripe. Measurement for striping with a plan width other than basic 4 inch or 12 inch as shown on the plans or as directed by the Engineer will be made by the following method:

Multiplier Factor for Payment of Thermoplastic Pavement Markings		
Line Width	4" (Item 1)	12" (Item 2)
4"	1.0x	n/a
6"	1.5x	n/a
8"	2.0x	n/a
10"	2.5x	n/a
12"	n/a	1.0x
16"	n/a	1.25x
24"	n/a	2.0x

Payment for extruded letters and symbols will be based on a unit price, which is defined in the contract and the **Payment Factor Table** included in this specification.

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, removing existing pavement markings, and for surface preparation using water blasting will be paid under separate items and are not included in this item.















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Payment will be made under:

Item	Pay Unit
4" Wide Thermoplastic Pavement Marking Line	Feet
12" Wide Thermoplastic Pavement Marking Line	Feet
Extruded Thermoplastic Letters and Symbols	Unit*

*See table on following page for table to be used in determining payment factor for extruded thermoplastic letters and symbols

**Payment Factors for Installation of
Extruded Thermoplastic Pavement Markings**

Type	Item	Extruded	
		SF	Units
Symbols	 Turn Arrow	15.50	1.00
	 Through (straight) Arrow	12.50	0.81
	 Combo Arrow	25.50	1.65
	 Combo Arrow (left/right)	27.00	1.74
	 Lane Reduction Arrow	42.00	2.71
	 Bicycle Facility Arrow	4.50	0.29
	 Wrong Way Arrow	24.40	1.57
	 HOV Lane	13.50	0.87
	 Sharks Teeth 12" x 18"	0.75	0.05
	 Sharks Teeth 24" x 36"	3.00	0.19
	 Speed Hump Marking	12.10	0.78
	 Bike Symbol 40" x 72"	N.A.	N.A.
	 Bike Symbol 24" x 48"	N.A.	N.A.
	 Ped Symbol 72"	N.A.	N.A.
8' Letters & Numbers	A	5.50	0.35
	B	7.10	0.46
	C	4.80	0.31
	D	6.10	0.39
	E	5.90	0.38
	F	4.70	0.30
	G	5.80	0.37
	H	6.00	0.39
	I	2.60	0.17
	J	3.70	0.24
	K	5.70	0.37
	L	3.80	0.25
	M	7.40	0.48
	N	7.10	0.46
	O	6.00	0.39
	P	5.30	0.34
	Q	6.30	0.41
	R	6.30	0.41
	S	5.70	0.37
	T	3.80	0.25
	U	5.60	0.36
	V	4.80	0.31
	W	7.30	0.47
	X	4.80	0.31
	Y	3.90	0.25
	Z	5.10	0.33
	1	2.60	0.17
	2	5.80	0.37
	3	5.80	0.37
	4	5.10	0.33
5	6.10	0.39	
6	6.20	0.40	
7	3.80	0.25	
8	6.70	0.43	
9	6.20	0.40	
0	6.00	0.39	
	10' School	94.00	6.06

Notes

- Letters and symbols shown to the left will be paid in accordance to the number of "Units" they represent.
- For extruded thermoplastic, "1 Unit" for bid determination is derived from FHWA-approved turn arrow symbol which is 15.50 SF.
- N.A. = Not Applicable because this option is not used by NYCDOT.
- Symbols / letters / numbers not shown may be added to the contract using the same methodology presented above for payment.
- See NYCDOT Typical Drawings in Exhibit A of this contract for typically utilized symbols and letter configurations.
- The factors listed in this table are fixed for the duration of the contract unless modified by change order.