

Section 02767

THERMOPLASTIC PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

This item includes white thermoplastic pavement markings for crosswalks, stop lines, lane lines, and other types of traffic controls.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for thermoplastic pavement markers under this Section unless included as a bid item in Document 00300 - Bid. Include payment in unit price for installation and maintenance of traffic control.
2. When included as a bid item in Document 00300 - Bid, payment for thermoplastic pavement markings is on a linear foot basis.
3. When included as a bid item in Document 00300 - Bid, payment for words and symbols is for each word or symbol.
4. When included as a bid item in Document 00300 - Bid, payment for railroad crossing markings, to include stop line and two transverse lines, is for each crossing marked.
 - a. For multi-lane approaches to railroad crossings, the solid 8-inch lane lines will be measured in linear feet, complete in place.
5. Unit price bid for each item includes full compensation for furnishing and placing all materials, and for all manipulations, including blast cleaning, surface sealing and priming, labor, tools, equipment, and incidentals necessary to complete Work in accordance with drawings and specifications.
6. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). When Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

- A. ASTM E 28 - Standard Test Methods for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus.**

- B. ASTM G 152 - Standard Practice for Operating Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.
- C. ASTM G 153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.
- D. TxDOT Tex-822-B - Determining Refraction Index of Glass Beads.
- E. TxDOT Tex-826-B - Water Absorption Test of Beads.
- F. TxDOT Tex-839-B - Determining Color in Reflective Material.
- G. TxDOT Tex-851-B - Evaluating the Abrasion Resistance of Pavement Marking Material.

1.04 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures.
- B. Product Data: Submit Manufacturer's literature indicating product specifications and instructions for handling, installation, and curing. Include performance test data sheets for each product.
- C. Submit material suppliers' certification of compliance with specifications.
- D. Submit proposed methods, equipment, and sequence of operation for layout, surface preparation, and installation.
- E. Chemical Analysis: Submit infrared analysis of Type B resins for each manufacturer used.

PART 2 PRODUCTS

2.01 MATERIAL REQUIREMENTS

- A. General Requirements. Especially compound Type B thermoplastic pavement marking material for use on either asphaltic or Portland cement concrete surfaces. Clearly mark each container to indicate color, weight, type of material, and lot or batch number (consider lot or batch as each individual mix or blend that produces finished product ready for use). Package material in either suitable corrugated containers or thermal degradable plastic bags to avoid sticking during shipment or storage.
- B. Thermoplastic markings shall not be slippery when wet, nor exhibit tacky, exposed surface. Cold ductility of material shall permit normal road surface expansion and contraction without chipping or cracking. Markings shall retain their original color, dimensions, and placement under normal traffic conditions at road surface temperatures of 158°F and below.

C. Prime and filler pigments shall pass U.S. Standard sieve No. 230 (0.0024 inch opening) when washed free of resins by solvent washing, and meet following specific requirements for each pigment.

1. Prime Pigments: White pigment shall be Rutile Titanium Dioxide.
2. Filler Pigment: Filler pigment shall be calcium carbonate, 95% purity.

D. Binder:

Type B - Alkyd: Use binder consisting of mixture of resins, at least one of which is solid at room temperature, and high boiling point plasticizers. At least one-third of binder compositions shall be a maleic-modified glyceryl ester 012 Rosin and shall be no less than 8 percent by weight of entire material formulation.

E. Glass Traffic Beads: the total silica used in formulation shall be in form of glass traffic beads meeting the following requirements:

1. Manufacture. Use glass traffic beads having the following characteristics:
 - a. Manufactured from glass;
 - b. Spherical in shape;
 - c. Free of sharp angular particles;
 - d. Free of particles showing milkiness, surface scoring, or surface scratching;
 - e. Water white in color.
2. Contaminants. Use glass traffic beads having the following characteristics:
 - a. Containing less than ¼ of 1 percent moisture by weight;
 - b. Free of trash, dirt, etc.;
 - c. Showing no evidence of objectionable static electricity when flowing through regular traffic-bead dispenser.
3. Gradation:
 - a. Sieve Analysis. Glass traffic beads shall meet following gradation requirements:

Openings U.S. Standard Sieves	Percent Passing
No. 20	95 - 100
No. 30	80 - 95
No. 50	15 - 35
No. 100	0 - 4

- b. Irregular Particles: Glass traffic beads, retained on screen used to determine gradation requirements, shall not contain more than 30 percent (by weight) irregular particles.
4. Index of Refraction: Glass traffic beads, when tested by TxDOT Tex-822-B, using liquid immersion method at 25°C (77°F) shall show index of refraction within range of 1.50 to 1.53.
5. Wetting. Use glass traffic beads capable of being readily wet with water when tested in accordance with TxDOT Tex-826-B.
6. Stability. Use glass traffic beads showing no tendency toward decomposition, surface etching, change in retro reflective characteristics, or change in color after:
 - a. One hour exposure to concentrated hydrochloric acid at 25°C (77°F);
 - b. Twenty-four-hour exposure to weak alkali;
 - c. One hundred hours of Weather-O-Meter exposure, in accordance with ASTM G 152 and ASTM G 153.

2.02 FINISHED PRODUCT REQUIREMENTS

- A. Physical Characteristics. Finished thermoplastic pavement markings material shall be free flowing granular material, unless otherwise shown on Drawings. Material shall remain in free flowing state in storage at temperatures of 100°F or less. Materials shall be readily sprayed through nozzles commonly used on thermoplastic spray equipment at temperatures between 205° and 218°C (401° to 425°F).
- B. Toxicity. At temperatures up to and including 230°C (446°F), materials shall not give off fumes which are toxic and otherwise injurious to persons, animals, or property.
- C. Material shall not break down or deteriorate when held at 205°C (401°F) for 4 hours.
- D. Temperature versus viscosity characteristics of material in plastic state shall remain constant throughout up to four reheatings at 205°C (401°F) and from batch to batch.
- E. Material shall not be adversely altered by contact with sodium chloride, calcium chloride, or other similar chemicals on, or used on, roadway surface; by contact with oil content of pavement materials, or by contact from oil dropping from traffic.
- F. Softening Point. After heating thermoplastic materials for 2 hours at 204°C (400°F) Type B Alkyd material shall have softening point greater than 90°C (194°F) when tested in accordance with ASTM E 28-58T - Ball and Ring Method.
- G. Color. CIE chromaticity coordinates of materials, when determined in accordance with TxDOT Tex-839-B, shall fall within area having following corner points and shall meet following luminosity requirements.

CIE Chromaticity Coordinate Corner Points									
	Point 1		Point 2		Point 3		Point 4		
Color	X	Y	X	Y	X	Y	X	Y	Luminosity
White	0.290 - 0.315		0.310 - 0.295		0.350 - 0.340		0.330 - .360		Min 65

Material shall meet above specified color requirements, before and after 70 hours of exposure in Weather-O-Meter (Atlas, Sunshine Type) fitted with 18 - 102 (18 minutes of sunshine and rain and 102 minutes of sunshine) cyclic gear. Prepare panels for testing with material as supplied.

- H. Abrasion. Thermoplastic pavement marking materials shall have loss between 4.0 and 12.0 grams when tested for abrasion in accordance with TxDOT Tex-851-B. Test according to steps 1 through 8 of procedure utilizing following test parameters:

Test distance: 5 inches
 Blast pressure: 40 psi
 Sample angle: 10 degrees and 122 grams blast media
 Blast Media: 1,200 grams

- I. Uniformity. Manufacture material so that, when sampled in accordance with TxDOT *Manual of Testing Procedures*, 100-gram sample will be representative of batch or lot of material.
- J. When applied 1/8 inch thick, setting time shall not exceed characteristic straight-line curve, lower limit of which is 4 minutes at 59°F road surface temperatures, and upper limit of which is 10 minutes at 90°F road surface temperature. Both temperatures are to be measured at maximum relative humidity of 90 percent.

2.03 FORMULAE

Type B - Alkyd Thermoplastic Marking:

	Pounds
Binder	18 - 23
Titanium Dioxide	12 - 15
Calcium Carbonate	20 - 42
Glass Traffic Beads	30 - 45
Total	100

PART 3 EXECUTION

3.01 GENERAL

- A. Spray, apply pavement marking, or extrude hot-to-pavement surface unless application method is specified on Drawings.

- B. Provide continuous mixing and agitation of material. Provide clean, square, marking ends. Do not use pans, aprons, or similar appliances, which die overruns.
- C. Provide thermometer capable of measuring temperature of pavement marking material.
- D. Use automatic bead dispenser attached to pavement marking equipment in manner that beads are dispensed uniformly and almost instantly upon marking as marking is being applied to road surface. Rate of application shall be sufficient to achieve retro-directive reflective characteristics specified. Provide automatic cut-off control for bead dispenser, synchronized with cut-off of pavement marking equipment.
- E. Place markings in accordance with approved traffic control plan so that minimal interruption to traffic flow is achieved. Protect newly-installed pavement markings from damage by traffic.
- F. Apply pavement markings onto clean, dry pavement having road surface temperature above 60°F and rising for Portland cement concrete surface and above 50°F and rising for asphaltic surface. When pavement marking application is by spray and operations cease for 5 or more minutes, flush spray head by spraying pavement marking material into pan or similar container until material is proper temperature for application.
- G. Use markings that are completely reflectorized internally and externally.
- H. Use crew experienced in work of installing pavement markings and supply all equipment and materials necessary for placement of pavement markings.
- I. Apply material within temperature limits recommended by manufacturer.
- J. Prior to placement of thermoplastic material, properly prepare pavement with primer.
- K. The appearance of the finished markings shall have a uniform surface, crisp edges with a minimum over-spray, clean cut-off, meet straightness requirements and conform to the design drawings and/or engineer instructions.
- L. The contractor shall provide the Project Manager with certification from the marking manufacturer that contractor has been adequately trained and certified to apply the manufacturer's material.

3.02 LAYOUT

- A. Place pavement markings in proper alignment with guidelines established on roadway. Do not deviate from alignment established greater than 2 inches. Do not deviate in alignment of marking being placed greater than 1 inch per 200 feet of marking and do not deviate abruptly.
- B. Place additional markings required to achieve alignment specified throughout both straight and horizontally curved sections of roadway. Additional markings placed on

roadway for alignment purposes shall be temporary in nature and shall not establish permanent marking on roadway. Materials used for alignment markings and equipment used to place markings shall be approved by Engineer.

3.03 PREPARATION

- A. Clean pavement by sandblasting and prepare in accordance with recommendations of thermoplastic material manufacturer and to satisfaction of Engineer, prior to placement of markings. Surface scarification can be used with prior approval of Engineer.
- B. It is the Contractor's responsibility to determine the method and degree of preparation required to sufficiently remove all dirt, dust, chemicals, oil, loose material, moisture, and other contaminants. Do not clean Portland cement concrete surfaces by grinding.
- C. Prepare Portland cement concrete surfaces further after cleaning by completely sealing with epoxy or methyl methacrylate sealer, as recommended by thermoplastic material manufacturer. Placed sealer sufficiently in advance of thermoplastic to allow release of all solvents.
- D. Prime asphaltic surfaces with sealer, as recommended by thermoplastic material manufacturer based on surface conditions. Include adhesive or adhesion promoter when asphaltic surfaces exhibit polished aggregate.
- E. All surfaces shall be inspected for moisture content prior to application of thermoplastic. Approximately two square feet of a clear plastic or tar paper shall be laid on the road surface and held in place for 15 to 20 minutes. The underside of the plastic or tar paper shall then be inspected for a buildup of condensed moisture from the road surface. Pavement is considered dry if there is no condensation on the underside of the plastic or tarpaper. In the event of moisture, this test shall be repeated until there is no moisture on the underside of the plastic or tar paper.

3.04 INSTALLATION

- A. Install in widths of 4, 6, 8, or 12 inches, or shaped otherwise as shown on Drawings. Tolerances in width shall not exceed $\frac{1}{8}$ inch. Tolerance shall not exceed $\frac{1}{4}$ inch in case of undulation in pavement.
- B. Material shall not prohibit adhesion of other thermoplastic markings if, at some future time, new markings are placed over existing materials.
- C. Maintain uniform thickness of each pavement marking. Minimum thickness of markings, as measured above plane formed by pavement surface, shall not be less than $\frac{1}{8}$ inch (125 mils), unless shown otherwise on Drawings. Maximum thickness shall be $\frac{3}{16}$ inch. Supply device, approved by Engineer, to measure thickness of applied extruded markings.

- D. All striping and pavement markings shall be placed in accordance with the requirements of this specification, the detailed plans, and the current edition of the Texas Manual on Uniform Traffic Control Devices (TMUTCD).

3.05 TESTING AND INSPECTION

Maintain uniform cross section, density, quality, and thickness for markings. Markings shall be uniform throughout their thickness. Use applied markings that are 95 percent free of holes and voids, and free of blisters for minimum of 60 days after application.

END OF SECTION