

**SECTION 02860
THERMOPLASTIC PAVEMENT MARKINGS**

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

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

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Payment for thermoplastic pavement markings is on a linear foot basis for the width of markings.
2. Payment for words and symbols is per each word or symbol.
3. Unit price bid for each shall be item 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 the Work in accordance with drawings and Technical Specifications.
5. Refer to Section 01270 – Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum):

1. When Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

A. ASTM – American Standards for Testing and Materials.

1. ASTM E28 – Standard Test Methods for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus.
2. ASTM G152 – Standard Practice for Operating Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.
3. ASTM G153 – Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.

B. CFTS – City of Friendswood Technical Specifications.

C. TxDOT – Texas Department of Transportation.

1. TxDOT Tex-822-B – Determining Refraction Index of Glass Beads.
2. TxDOT Tex-826-B – Water Absorption Test of Beads.
3. TxDOT Tex-839-B – Determining Color in Reflective Material.
4. TxDOT Tex-851-B – Evaluating the Abrasion Resistance of Pavement Marking Material.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.

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- 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 supplier's certification of compliance with the Technical 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 II: PRODUCTS

2.1 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, and shall not 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 one hundred fifty-eight degrees Fahrenheit (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. Yellow pigment shall be a heat-resistant, double-encapsulated medium chrome yellow or other approved heat-resistant pigment.
 - 2. Filler Pigment: Filler pigment shall be calcium carbonate, with a purity of ninety-five percent (95%).
- D. Binder
 - 1. Type B – Alkyd: Use binder consisting of mixture of resins, at least one (1) of which is solid at room temperature and high boiling point plasticizers. At least one-third (1/3) of binder compositions shall be a maleic-modified glyceryl ester 012 Rosin and shall be no less than eight percent (8%) by weight of entire material formulation.
- E. Glass Traffic Beads: The total silica used in formulation shall be in the form of glass traffic beads meeting the following requirements:
 - 1. Manufacture: Use glass traffic beads having the following

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- 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 one-quarter of one percent (0.25%) moisture by weight;
 - b. Free of trash, dirt, etc;
 - c. Showing no evidence of objectionable static electricity when flowing through traffic-bead dispenser.
3. Gradation:
- a. Sieve Analysis: Glass traffic beads shall meet gradation requirements specified in TABLE 4.1 – GLASS TRAFFIC BEADS SIEVE ANALYSIS, in this Section.
 - b. Irregular Particles: Glass traffic beads, retained on screen used to determine gradation requirements, shall contain not more than thirty percent (30%) (by weight) of irregular particles.
4. Index of Refraction: Glass traffic beads, when tested by TxDOT Tex-822-B, using liquid immersion method at seventy-seven degrees Fahrenheit (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 (1 Hr) exposure to concentrated hydrochloric acid at seventy-seven degrees Fahrenheit (77° F);
 - b. Twenty-four hour (24 Hr) exposure to weak alkali;
 - c. One hundred hours (100 Hrs) of Weather-O-Meter exposure, in accordance with ASTM G152 and ASTM G153.

2.2 FINISHED PRODUCT REQUIREMENTS

- A. Physical Characteristics: Finished thermoplastic pavement markings material shall be free-flowing granular material, unless otherwise shown on the Drawings. Material shall remain in free flowing state in storage at temperatures of one hundred degrees Fahrenheit (100° F) or less. Materials shall be readily sprayed through nozzles commonly used on thermoplastic spray equipment at temperatures between four hundred one degree Fahrenheit (401° F) to four hundred twenty-five degrees

- Fahrenheit (425° F).
- B. Toxicity: At temperatures up to and including four hundred forty-six degrees Fahrenheit (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 four hundred one degrees Fahrenheit (401° F) for four hours (4 Hrs).
 - D. Temperature versus viscosity characteristics of material in plastic state shall remain constant throughout up to four reheatings at four hundred one degrees Fahrenheit (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 two hours (2 Hrs) at four hundred degrees Fahrenheit (400° F) Type B Alkyd material shall have softening point greater than 194 degrees Fahrenheit when tested in accordance with ASTM E28-58T – 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 luminosity requirements specified in TABLE 4.2 – CIE CHROMATICITY COORDINATE CORNER POINTS LUMINISITY REQUIREMENTS, in this Section. Material shall meet above specified color requirements, before and after seventy hours (70 Hrs) of exposure in Weather-O-Meter (Atlas, Sunshine Type) fitted with [eighteen minutes (18 Min) sunshine and rain to one hundred two minutes (102 Min) of sunshine] cyclic gear. Prepare panels for testing with material as supplied.
 - H. Abrasion: Thermoplastic pavement marking materials shall have loss between four grams (4 g) and twelve grams (12 g) when tested for abrasion in accordance with TxDOT Tex-851-B. Test according to steps one (1) through eight (8) of procedure utilizing test parameters specified in TABLE 4.3 – ABRASION TEST FOR THERMOPLASTIC PAVEMENT MARKING MATERIALS, in this Section.
 - I. Uniformity: Manufacture material so that, when sampled in accordance with TxDOT Manual of Testing Procedures, a one hundred gram (100 g) sample shall be representative of the batch or lot of material.
 - J. When applied one-eighth inch (1/8 In) thick, setting time shall not exceed characteristic straight-line curve lower limit which is four minutes (4 Min) at fifty-nine degrees Fahrenheit (59° F) road surface temperatures and upper limit of which is ten (10) minutes at ninety degrees Fahrenheit (90° F) road surface temperature. Both temperatures are to be measured at a maximum relative humidity of ninety percent (90%).

2.3 FORMULAE

- A. Type B – Alkyd Thermoplastic Marking shall be as specified in TABLE 4.4 – TYPE B ALKYD THERMOPLASTIC MARKING FORMULA, in this Section.

PART III: EXECUTION

3.1 GENERAL

- A. Spray apply pavement marking or extrude hot material to pavement surface unless application method is specified on the 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-reflective characteristics specified. Provide automatic cut-off control for bead dispenser, synchronized with cut-off of pavement marking application process.
- E. Place markings in accordance with approved traffic control plan so that minimal interruption to traffic flow is achieved, or so that driver confusion is minimized. Protect newly-installed pavement markings from damage by traffic.
- F. Apply pavement markings onto clean, dry pavement having road surface temperature above sixty degrees Fahrenheit (60° F). When pavement marking application is by spray and operations cease for five minutes (5 Min) or more, 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 the 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.

3.2 LAYOUT

- A. Place pavement markings in proper alignment with guidelines established on roadway. Do not deviate from alignment established greater than two inches (2 In). Do not deviate in alignment of marking being placed greater than one inch (1 In) per two hundred feet (200 Ft) 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 be established as permanent marking on roadway. Materials used for alignment markings and equipment used to place markings shall be approved by the Project Manager.

3.3 SURFACE PREPARATION

- A. Clean pavement by sandblasting and prepare in accordance with recommendations of thermoplastic material manufacturer and to satisfaction of the Project Manager prior to placement of markings. Surface scarification can be used with prior approval of the Project Manager.
- B. Use cleaning methods approved by the Project Manager that completely remove contaminants, loose materials and conditions deleterious to proper adhesion. Do not clean Portland cement concrete surfaces by grinding.
- C. Further prepare Portland cement concrete surfaces after cleaning by completely sealing with epoxy or methyl methacrylate sealer as recommended by thermoplastic material manufacturer. Place sealer sufficiently in advance of thermoplastic to allow release of all solvents.
- D. Prime asphaltic surfaces with sealer as recommended by thermoplastic material manufacturer and based on surface conditions. Include adhesive or adhesion promoter when asphaltic surfaces exhibit polished aggregate.

3.4 INSTALLATION

- A. Install in widths of four inches (4 In), six inches (6 In), eight inches (8 In) or twelve inches (12 In) or shape as otherwise shown on the Drawings. Tolerances in width shall not exceed one-eighth inch (1/8 In). Tolerance shall not exceed one-quarter inch (1/4 In) 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 or across existing materials.
- C. Maintain uniform thickness of each pavement marking. The minimum thickness of markings, as measured above plane formed by pavement surface, shall not be less than one-eighth inch (1/8 In), one hundred twenty-five mils (125 mils), unless shown otherwise on the Drawings. The maximum thickness shall be three-sixteenths inch (3/16 In). Supply device approved by the Project Manager to measure thickness of applied extruded markings.

3.5 TESTING

- A. Maintain uniform cross section, density, quality and thickness for markings. Markings shall be uniform throughout their thickness. Use applied markings that are ninety-five percent (95%) free of holes and voids and free of blisters for a minimum of sixty days (60 D) after application.

PART IV: TABLES

4.1 GLASS TRAFFIC BEADS SIEVE ANALYSIS

OPENINGS U.S. STANDARD SIEVES	PERCENT PASSING
No. 20	95 – 100
No.30	80 – 95
No. 50	15 – 35
No. 100	0 – 4

4.2 CIE CHROMATICITY COORDINATE CORNER POINTS LUMINISITY REQUIREMENTS

	POINT 1	POINT 2	POINT 3	POINT 4	
Color	X Y	X Y	X Y	X Y	Luminosity
White {tc \ 12" White}	0.290 – 0.315	0.310 – 0.295	0.350 – 0.340	0.330 – 0.360	Minimum 65

4.3 ABRASION TEST FOR THERMOPLASTIC PAVEMENT MARKING MATERIALS

THERMOPLASTIC MARKINGS TEST PARAMETERS	
TEST PARAMETERS	VALUE
Test Distance	5 Inches
Blast Pressure	40 psi
Sample Angle	10° and 122 gram blast media
Blast Media	1200 grams

4.4 TYPE B – ALKYD THERMOPLASTIC MARKING FORMULA

MATERIAL	POUNDS
Binder	18 – 23
Titanium Dioxide	12 – 15
Calcium Carbonate	20 – 42
Glass Traffic Beads	30 – 45
TOTAL	100

END OF SECTION