

University of Houston Master Specification

<Insert Project Name>
<Insert U of H Proj #>

<Insert Issue Name>
<Insert Issue Date>

SECTION 32 1723.33 – THERMOPLASTIC PAVEMENT MARKINGS

Maintain Section format, including the UH master spec designation and version date in bold in the center columns of the header and footer. Complete the header and footer with Project information

Edit and finalize this Section, where prompted by Editor's notes, to suit Project specific requirements. Make selections for the Project at text identified in bold.

This Section uses the term "Engineer." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

Delete hidden text after this Section has been edited for the Project.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
 - 1. The current version of the *Uniform General Conditions for Construction Contracts*, State of Texas, available on the web site of the Texas Facilities Commission.
 - 2. The University of Houston's *Supplemental General Conditions and Special Conditions for Construction*.

1.2 SUMMARY

- A. This Section includes white thermoplastic pavement markings for crosswalks, stop lines, lane lines, words, symbols and other types of traffic controls in campus roadways; and green thermoplastic pavement markings in bike lanes and at bike crossings.

1.3 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.

<Insert A/E Name>
AE Project #: <Insert Project
Number>

Thermoplastic Pavement Markings
UH Master: 12.2020

32 1723.33 - 1

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- 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.

1.4 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's literature indicating product specifications and instructions for handling, installation, and curing. Include performance test data sheets for each product.
- B. Materials Certification: Submit material supplier's certification of compliance with Specifications.
- C. Chemical Analysis: Submit infrared analysis of Type B resins for each manufacturer used.
- D. Contractor Certification: Submit certification(s) from the pavement marking manufacturer(s) that Contractor has been adequately trained and certified to apply the manufacturer's material. This certification shall be considered current if the certification date provided by the manufacturer is within two years of the date of application of pavement markings.

1.5 QUALITY ASSURANCE

- A. Employ workers experienced in work of installing pavement markings.

PART 2 - PRODUCTS

2.1 MATERIAL REQUIREMENTS

- A. General Requirements: Thermoplastic pavement marking material Type B 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

<Insert A/E Name>

AE Project #: <Insert Project Number>

Thermoplastic Pavement Markings

UH Master: 12.2020

32 1723.33 - 2

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

chipping or cracking. Markings shall retain their original color, dimensions, and placement under normal traffic conditions at road surface temperatures of 158 degrees 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 percent purity.
- D. Binder
1. 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 1/4 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 the 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 degrees C (77 degrees F), shall show index of refraction within range of 1.50 to 1.53.

<Insert A/E Name>

Thermoplastic Pavement Markings

32 1723.33 - 3

AE Project #: <Insert Project Number>

UH Master: 12.2020

University of Houston Master Specification

<Insert Project Name>
<Insert U of H Proj #>

<Insert Issue Name>
<Insert Issue Date>

- 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 degrees C (77 degrees 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.

2.2 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 degrees F or less. Materials shall be readily sprayed through nozzles commonly used on thermoplastic spray equipment at temperatures between 205 and 218 degrees C (401 to 425 degrees F).

- B. Toxicity. At temperatures up to and including 230 degrees C (446 degrees F), materials shall not give off fumes that are toxic and otherwise injurious to persons, animals, or property.

- C. Material shall not break down or deteriorate when held at 205 degrees C (401 degrees F) for 4 hours.

- D. Temperature versus viscosity characteristics of material in plastic state shall remain constant throughout up to four re-heatings at 205 degrees C (401 degrees 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 at 204 degrees C (400 F) Type B Alkyd material shall have softening point greater than 90 degrees C (194 degrees 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					
	1	2	3	4	Brightness

<Insert A/E Name>
AE Project #: <Insert Project
Number>

Thermoplastic Pavement Markings
UH Master: 12.2020

32 1723.33 - 4

University of Houston Master Specification

<Insert Project Name>
<Insert U of H Proj #>

<Insert Issue Name>
<Insert Issue Date>

	x	y	x	y	x	y	x	y	Y
White	0.290	0.315	0.310	0.295	0.350	0.340	0.330	0.360	Min 65

- H. 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.
- I. 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 gram blast media
 - Blast Media: 1200 grams
- J. 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.
- K. When applied 1/8 inch thick, setting time shall not exceed characteristic straight-line curve, lower limit of which is four minutes at 59 degrees F road surface temperatures, and upper limit of which is ten minutes at 90 degrees F road surface temperature. Both temperatures are to be measured at maximum relative humidity of 90 percent.

2.3 FORMULA

- A. Type B - Alkyd Thermoplastic Marking:

	Pounds
Binder	18 - 23
Titanium Dioxide	12 - 15
Calcium Carbonate	20 - 42
Glass Traffic Beads	<u>30 - 45</u>
	TOTAL 100

PART 3 - EXECUTION

3.1 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 that allow dye to overrun.

<Insert A/E Name>
AE Project #: <Insert Project
Number>

Thermoplastic Pavement Markings
UH Master: 12.2020

32 1723.33 - 5

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- 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 degrees F for Portland cement concrete surface and above 55 degrees F for asphaltic surface. When pavement marking application is by spray and operations cease for five 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. Apply material within temperature limits recommended by manufacturer.
- I. 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 more than two inches from guidelines established. Do not deviate in alignment of marking being placed greater than one 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.
- C. Place striping and pavement markings in accordance with the requirements of this Section, the Drawings, and the current edition of the *Texas Manual on Uniform Traffic Control Devices*. Contractor shall provide all other engineering services necessary for pre-marking of all proposed stripes and pavement markings within the limits of the Work.

3.3 SURFACE 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 may be used with prior approval of Engineer.

<Insert A/E Name>

Thermoplastic Pavement Markings

32 1723.33 - 6

AE Project #: <Insert Project
Number>

UH Master: 12.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- B. Use cleaning methods approved by Engineer that completely remove contaminants, loose materials, and conditions deleterious to proper adhesion. 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. 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 based on surface conditions. Include adhesive or adhesion promoter when asphaltic surfaces exhibit polished aggregate.
- E. Primer Sealer Application. When required as described, the primer-sealer shall be applied to the road surface in a continuous film at a minimum thickness of 3 to 5 mils. Before the thermoplastic is applied, the primer-sealer shall be allowed to dry to a tacky state. The thermoplastic shall be applied within 4 hours after the primer application.

3.4 INSTALLATION

- A. Install markings in widths shown on Drawings. Tolerances in width shall not exceed 1/8 inch or 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 1/8 inch (125 mils). Maximum thickness shall be 3/16 inch. Supply device, approved by Engineer, to measure thickness of applied extruded markings.
- D. Drop-on Glass Sphere Application
 - 1. Application Rate. Retro-reflective glass spheres shall be applied at the rate of 10 pounds per 100 square feet of applied markings. This application rate shall be determined by confirming the following consumption rates:
 - a. 150 pounds of drop on glass spheres per ton of applied thermoplastic when the thermoplastic is being applied at 0.125 inch thickness.
 - 2. Application Method. Retro-reflective glass spheres shall be applied by a mechanical dispenser properly calibrated and adjusted to provide proper application rates and uniform distribution of the spheres across the cross section of the entire width of the line. To enable the spheres to embed themselves into the hot thermoplastic, the sphere dispenser shall be positioned immediately behind the thermoplastic application device. This method insures that the spheres are applied to the thermoplastic material while it is still in the molten state.

<Insert A/E Name>

AE Project #: <Insert Project Number>

Thermoplastic Pavement Markings

UH Master: 12.2020

32 1723.33 - 7

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- E. 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.

- F. Finished markings shall have a uniform surface and crisp edges with a clean cut-off and minimum over-spray; meet straightness requirements; and conform to the Drawings and/or Engineer's instructions.

END OF SECTION 32 1723.33

<Insert A/E Name>

AE Project #: <Insert Project
Number>

Thermoplastic Pavement Markings
UH Master: 12.2020

32 1723.33 - 8