

SECTION 15

SPECIAL PROVISIONS - PAVEMENT MARKING SPECIFICATIONS

15-1 REFLECTORIZED PAVEMENT MARKINGS:

- A. **DESCRIPTION:** This item shall govern for furnishing and placing reflectORIZED pavement markings of the types, colors, shapes, sizes, widths, and thickness shown on the plans.
- B. **MATERIALS:**
1. **Type I Marking Materials:** Type I markings are thermoplastic type materials that require heating to elevated temperatures for application. Thermoplastic marking materials shall conform to Texas Department of Transportation (TxDOT) Materials Specification D-9-8220. Each container of Type I marking material shall be clearly marked to indicate the color, weight, type of material, manufacturer's name and the lot/batch number.
 2. **Type II Marking Materials:** Type II markings are paint-type materials that are applied at ambient or slightly elevated temperatures, and shall only be used as a sealer. Type II marking materials shall conform to TxDOT Materials Specifications D-9-8200, YPT-10 and/or WPT-10 and D-9-82-90. (Rev. 7/10)
 3. **Source of Supply:** All materials, including all glass traffic beads, shall be purchased on the open market.
 4. **Symbols:** All symbols shall be preformed, white and retro-reflectORIZED. (Rev. 6/12)
- C. **EQUIPMENT REQUIREMENTS:** Equipment used to place pavement markings shall:
1. Be maintained in satisfactory operating condition.
 2. Be considered in satisfactory operating condition if it has an average placement rate of 5,000 linear feet per hour of acceptable four-inch solid or broken lines over any five (5) consecutive working days.
 3. Meet or exceed the material handling at elevated temperature requirements of the National Fire Underwriters and the Texas Railroad Commission.
 4. Be capable of placing a minimum of 40,000 linear feet of four-inch solid or broken markings per working day.
 5. Have production capabilities similar to four-inch marking equipment and shall be capable of placing linear markings up to eight inches (8") in width in a single pass when used for placing markings in widths other than four inches (4").

6. Have production capabilities considered satisfactory by the Engineer when used to place markings other than solid or broken lines.
7. Be capable of placing a center-line and no-passing barrier-line configuration consisting of one (1) broken line with two (2) solid lines at the same time to the alignment and spacing shown on the plans.
8. Be capable of placing broken and/or continuous white line from both sides.
9. Be capable of placing lines with clean edges and of uniform cross-sections. All lines shall have a tolerance of plus or minus 1/8 inch per four inch (4") width.
10. Have an automatic cut-off device with manual operating capabilities to provide clean, reasonably square marking ends to the satisfaction of the Engineer, and to provide a method of applying broken line in an approximate stripe-to-gap ratio of 10 to 30. The length of the stripe shall not be less than 10 feet or more than 10.5 feet. The total length of any stripe-gap cycle shall not be less than 39.5 feet or more than 40.5 feet.
11. Provide continuous mixing and agitation of the pavement marking materials. The use of pans, aprons or similar appliances, which the die overruns, will not be permitted for longitudinal striping applications.
12. Apply beads by an automatic bead dispenser attached to the pavement marking equipment in such a manner that the beads are dispensed uniformly and almost instantly upon the marking as the marking is being applied to the road surface. The bead dispenser shall have an automatic cut-off control, synchronized with the cut-off of the pavement marking equipment.
13. When Type I markings are to be placed, the Contractor shall have a hand-held thermometer on the project. The thermometer shall be capable of measuring the temperature of the pavement marking material to be placed.

D. CONSTRUCTION METHODS:

1. **General:** When required by the Engineer, the Contractor and the Engineer shall review the sequence of work to be followed and the estimated progress schedule.

Markings may be placed on roadways either free of traffic or open to traffic. On roadways already open to traffic, the markings shall be placed under traffic conditions that exist with a minimum of interference to the operations of the facility. Traffic Control shall follow the guidelines set forth in the City of Arlington Work Area Traffic Control Manual. All markings placed under open-traffic conditions shall be protected from traffic damage and disfigurement. On roadways open to traffic, with three (3) lanes of travel in one direction, all markings shall be placed from the outside lanes only, unless otherwise approved by the Engineer.

Guides to mark the lateral location of pavement markings shall be established as shown on the plans or as directed by the Engineer. The Contractor shall establish the pavement marking guides and the Engineer will verify the location of the guides.

Markings shall be placed in proper alignment with the guides. The deviation rate in alignment shall not exceed one inch (1") per 200 feet of roadway. The maximum deviation shall not exceed two inches (2") nor shall any deviation be abrupt.

Markings shall essentially have a uniform cross-section. The density and quality of markings shall be uniform throughout their thickness. The applied markings shall have no more than five percent (5%), by area, of holes or voids and shall be free of blisters.

Markings, in place on the roadway, shall be reflectorized both internally and externally. Glass beads shall be applied to the materials at a uniform rate sufficient to achieve uniform and distinctive retroreflective characteristics when observed in accordance with Test Method Tex-828-B of TxDOT Manual of testing procedures.

The Contractor's personnel shall be sufficiently skilled in the work of installing pavement markings.

Markings placed that are not in alignment or sequence, as shown on the plans or as stated in this specification, shall be removed by the Contractor at the Contractor's expense. Removal shall be in accordance with Section 15-3, "Eliminating Existing Pavement Markings and Markers," of this specification except for measurement and payment. Guides placed on the roadway for alignment purposes shall not establish a permanent marking on the roadway. (Rev. 7/10)

2. **Surface Preparation:** New portland cement concrete surfaces shall be cleaned in accordance with Section 15-4, "Pavement Surface Preparation for Markings" of this specification to remove curing membrane, dirt, grease, loose and/or flaking existing construction markings, and other forms of contamination.

Older portland cement concrete surfaces and asphaltic surfaces that exhibit loose and/or flaking existing markings shall be cleaned in accordance with Section 15-4, "Pavement Surface Preparation for Markings," to remove all loose and flaking markings.

Pavement to which material is to be applied shall be completely dry. Pavements shall be considered dry if, on a sunny day after observation for 15 minutes, no condensation occurs on the underside of a one foot (1') square piece of clear plastic that has been placed on the pavement and weighted on the edges.

3. **Application of Type I Markings:** New portland cement concrete surfaces shall be further prepared for Type I markings, after cleaning, by placing a Type II marking

as a sealer in accordance with this section. When placing Type I markings in new locations on asphaltic surfaces three (3) years old or older or any portland cement concrete surfaces, a Type II marking shall be used as a sealer. Unless otherwise shown on the plans, existing portland cement concrete and asphaltic surfaces to be restriped will not require Type II markings as a sealer; existing markings may be used as a sealer in lieu of Type II markings. Type II markings shall be placed a minimum of two (2) and a maximum of 30 calendar days in advance of placing Type I markings. Type II markings which become dirty due to inclement weather or road conditions shall be cleaned by washing, brushing, compressed air or other means approved by the engineer, prior to application of Type I markings. If washing is used, the surface of Type II markings shall become thoroughly dry before placing Type I markings. Color, location and configuration of Type II markings shall be the same as that of Type I markings.

Type I pavement marking material shall be applied within temperature limits recommended by the material manufacturer. Application of Type I pavement markings shall be done only on clean, dry pavement having a surface temperature above 50°F. Pavement temperature shall be measured in accordance with Test Method Tex-829-B of TxDOT Manual of Testing Procedures.

When Type I pavement marking application is by spray, and operations cease for five (5) minutes or more, the spray head shall be flushed by spraying pavement marking material into a pan or similar container until the pavement marking material being sprayed is at the proper temperature for application.

Unless otherwise directed by the Engineer, Type I pavement marking materials shall not be placed on roadways between September 30 and March 1, subject to temperature and moisture limitations specified herein.

Unless otherwise shown on the plans, Type I marking minimum thickness shall be 0.060 inches (60 mil) for edgeline markings and 0.090 inches (90 mil) for stop-bars, legends, symbols, gore and center-line/no-passing barrier-line markings, when measured in accordance with Test Method Tex-854-B of TxDOT Manual of Testing Procedures. The maximum thickness of all Type I markings shall be 0.180 inches (180 mil). The markings shall be of uniform thickness throughout their lengths and widths.

4. **Application of Type II Markings:** The application of Type II marking materials shall be done only on surfaces with a minimum surface temperature of 50°F.

The application rate for Type II marking material shall be between 15 and 20 gallons per mile of solid four inch (4") line and between 30 and 40 gallons per mile for solid eight inch (8") line except that for new surface treatment projects the application rate shall be between 25 and 30 gallons per mile of solid four inch (4") line and between 40 and 50 gallons per mile for solid eight inch (8") line.

Pavement markings for new surface treatment projects shall be applied in two (2) applications each approximately one-half the application rate. The first application shall not contain glass beads. The interval between the first and second applications shall be a minimum of one (1) hour.

When, in the case of impending inclement weather, and the Engineer directs the Contractor to apply water-based traffic paint, the markings are damaged by subsequent rain, sleet, hail, etc., the Contractor will be paid for the initial placement and the replacement markings. However, if the Contractor places the markings at his option, the Contractor is responsible for all costs associated with the replacement markings.

E. **PERFORMANCE PERIOD FOR TYPE I MARKINGS:** Type I pavement markings shall meet all requirements of this specification for a minimum of 365 calendar days after installation. Pavement markings that fail to meet all requirements of this specification shall be removed and replaced by the Contractor at the Contractor's expense. The Contractor shall replace all pavement markings failing the requirements of this specification within 30 calendar days following notification by the Engineer of such failing. All replacement markings shall also meet all requirements of this specification for a minimum of 365 calendar days after installation. (Rev. 7/10)

F. **MEASUREMENT:** This item will be measured by the linear foot, by each of the various words, symbols or shapes, or by any other unit as shown on the plans. Linear foot measurement will be for the actual material placed and will not include the spaces or gaps. Where double stripes are placed, each stripe will be measured separately. (Rev. 1/11)

Type II pavement markings requiring two (2) applications on new surface treatments will be measured as one (1) marking.

Type II pavement marking materials, when used as a sealer for Type I markings will be considered as part of Type II markings.

G. **PAYMENT:** The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Reflectorized Pavement Markings" of the various types, colors, shapes, sizes, widths, and thickness (Type I markings only) specified. This price shall be full compensation for furnishing all materials, surface preparation, for application of pavement markings, and for all other labor, tools, equipment and incidentals necessary to complete the work.

15-2 RAISED PAVEMENT MARKERS:

A. **DESCRIPTION:** This item shall govern for furnishing and installing raised pavement markers of the various classes and types shown on the plans.

B. **MATERIALS:** Raised pavement markers shall comply with the requirements of Departmental Materials Specifications as follows:

Class A, Jiggle Bar Tile D-9-4100

Class B, Pavement Markers (Reflectorized) D-9-4200

Class C, Traffic Buttons D-9-4300

Class D, Traffic Buttons (Oval) D-9-4300

Class E, Pavement Markers (All - Weather Reflectorized) D-9-4210

Raised pavement markers shall be of the following classes and types:

Class A - Raised Pavement Markers (Jiggle Bar Tile). Class A raised pavement markers shall include Types: I-A, I-C, II-A-A, W and Y.

Class B - Raised Pavement Markers (Pavement Markers, Reflectorized). Class B raised pavement markers shall include Types: I-A, I-C, I-R, II-A-A and II-C-R.

Class C and D - Raised Pavement Markers (Traffic Buttons). Class C and D raised pavement markers shall include Types: I-A, I-C, I-R, II-A-A, II-C-R, W and Y.

Class E - Raised Pavement Markers (All Weather Reflectorized). Class E raised pavement markers shall include Types: I-A, I-C, I-R, II-A-A and II-C-R. The body color descriptions do not apply to Class E raised pavement markers.

The following are descriptions for each type of raised pavement marker:

Type I-A. Type I-A shall contain an approach face that reflects amber light. The body, other than the reflective face, shall be yellow.

Type I-C. Type I-C shall contain an approach face that reflects white light. The body, other than the reflective face, shall be white, silver-white or light gray.

Type I-R. Type I-R shall contain a trailing face that reflects red light. The body, other than the reflective face, shall be white, silver-white, light gray or may be one-half red on the side which reflects red light.

Type II-A-A. Type II-A-A shall contain two (2) reflective faces (approach and trailing) each of which shall reflect amber light. The body, other than the reflective faces, shall be yellow.

Type II-C-R. Type II-C-R shall contain two (2) reflective faces, an approach face which shall reflect white light and a trailing face which shall reflect red light. The body, other than the reflective faces, shall be white, silver-white or light gray. Optionally, the body may be one-half white, silver-white or light gray on the side that reflects white light and one-half red on the side that reflects red light.

Type W. Type W shall have a white body and no reflective faces.

Type Y. Type Y shall have a yellow body and no reflective faces.

The reflective faces of all Type II markers shall be positioned so that the direction of reflection of one (1) face shall be directly opposite to the direction of reflection of the other face.

Bituminous adhesive shall conform to the requirements of TxDOT Materials Specification D-9-6130. Epoxy adhesive shall conform to the requirements as specified in TxDOT Standard Specifications for Construction of Highways, Streets and Bridges, Item 575, "Epoxy."

- C. SAMPLING: Sampling will be in accordance with TxDOT Test Method Tex 729-I.
- D. CONSTRUCTION METHODS: Each class of raised pavement marker shall be from the same manufacturer.

Surfaces to which markers are to be attached by an adhesive shall be prepared by any method approved by the Engineer to ensure that the surface is free of dirt, curing compound, grease, oil, moisture, loose or unsound pavement markings, and any other material which would adversely affect the adhesive bond. Unless otherwise shown on the plans, surface preparation for installation of raised pavement markers will not be paid for directly, but shall be considered subsidiary to this item.

Guides to mark the lateral location of pavement markings shall be established as shown on the plans or as directed by the Engineer. The Contractor shall establish the pavement marking guides and the Engineer will verify the location of the guides.

The pavement markers shall be placed in proper alignment with the guides. The deviation rate in alignment shall not exceed one inch (1") per 200 feet of roadway. The maximum deviation shall not exceed two inches (2") nor shall any deviation be abrupt.

Markers placed that are not in alignment or sequence, as shown on the plans or as stated in this specification, shall be removed by the Contractor at the Contractor's expense. Removal shall be in accordance with Section 15-3, "Eliminating Existing Pavement Markings and Markers," of this specification except for measurement and payment. Guides placed on the roadway for alignment purposes shall not establish a permanent marking on the roadway.

Unless otherwise shown on the plans, the Contractor shall use the following adhesive materials for placement of markers:

Epoxy adhesive for Class E markers.

Bituminous adhesive for Class A, B, C and D markers on bituminous pavements.

Epoxy adhesive for Class A, B, C and D markers on portland cement concrete pavements.

Adhesive shall be applied in sufficient quantity to ensure the following:

100 percent of the bonding area of raised pavement markers shall be in contact with the adhesive.

Raised pavement markers, except for Class E, shall not be in contact with the pavement surface but shall be seated on a continuous layer of adhesive.

Unless otherwise required by this item, adhesives shall be applied in accordance with the manufacturer's recommendations.

When bituminous adhesive is used, pavement and raised pavement marker temperature shall be at least 40°F. The bituminous adhesive shall not be heated above 400°F. The bituminous adhesive shall be agitated intermittently to ensure even heat distribution.

Epoxy adhesive shall be machine mixed.

Raised pavement markers shall be free of rust, scale, dirt, oil, grease, moisture or contaminants which might adversely affect the adhesive bond.

Raised pavement markers shall be placed immediately after the adhesive is applied and shall be firmly bonded to the pavement. Adhesive or any other material that impairs functional reflectivity will not be acceptable.

- E. MEASUREMENT: This item will be measured as each raised pavement marker.
- F. PAYMENT: The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Raised Pavement Markers" of classes and types specified. This price shall be full compensation for furnishing all materials, surface preparation, installation, labor, equipment, tools and incidentals necessary to complete the work.

15-3 ELIMINATING EXISTING PAVEMENT MARKINGS AND MARKERS:

- A. DESCRIPTION: This item shall govern for the elimination of existing pavement markings of the various types and sizes, and raised pavement markers as shown on the plans or as directed, in writing, by the Engineer.
- B. MATERIALS: All surface treatment material application rates shall be as directed by the Engineer. Unless otherwise shown on the plans, surface treatment materials shall conform to the requirements of "Asphalts, Oils and Emulsions," and "Aggregates For Surface Treatments" as specified in TxDOT Pavement Marking Specification. Testing of surface treatment materials may be waived by the Engineer. Asphalt and aggregate types and grades shall be as shown on the plans or as approved in writing by the Engineer.
- C. CONSTRUCTION METHODS: Elimination of existing pavement markings and

markers shall be accomplished by one (1) or more of the following methods as approved by the Engineer.

1. **Markings on Asphaltic Surfaces:**

- a. Placement of a surface treatment a minimum of two feet (2') wide to cover the existing marking.
- b. Placement of a surface treatment, thin overlay or microsurfacing a minimum of one (1) lane in width in areas where directional changes of traffic are involved or other areas as directed by the Engineer.

Construction methods for surface treatments shall conform to Item 316, "Surface Treatments" as specified in TxDOT Standard Specifications for Construction of Highways, Streets and Bridges.

2. **Markings on Concrete Surfaces:** Removal by an approved burning method.

3. **Markings on Asphaltic or Concrete Surfaces:** Removal by water, water-sand blasting techniques or by any other method(s) proven satisfactory to the Engineer.

4. **Markers on Asphaltic or Concrete Surfaces:** Removal by any mechanical method to remove marker and adhesive.

Existing pavement markings and markers on both concrete and asphaltic surfaces shall be removed in such a manner that color and/or texture contrast of the pavement surface will be held to a minimum.

Removal of pavement markings on concrete surfaces by blast cleaning shall be in accordance with Section 15-4, "Pavement Surface Preparation for Markings," of this specification. Blast cleaning shall be performed in such a manner that damage to the concrete surface is held to a minimum.

When thermoplastic pavement markings or prefabricated pavement markings are encountered, the application of heat may be used to remove the bulk of the marking material prior to blast cleaning. When heat is used, care shall be taken to prevent spalling of concrete surfaces.

A burner may be used for complete removal of pavement markings. Broom removal or light blast cleaning may be used for removal of minor residue.

Damage, such as spalling, shelling, etc. greater than 1/4 inch in depth, caused to asphaltic surfaces resulting from the removal of pavement markers shall be repaired by the application of a two foot (2') wide surface treatment for longitudinal markers with no directional change or a minimum of one (1) lane width surface treatment in areas where directional changes of traffic are involved.

Grinding is not an acceptable method of marker or marking removal. However, equipment utilizing special milling flails are considered acceptable in the removal of markings and markers on asphalt and concrete surfaces.

- D. MEASUREMENT AND PAYMENT: The work performed and material furnished in accordance with this item shall be considered subsidiary to unit prices bid for new pavement markings.

15-4 PAVEMENT SURFACE PREPARATION FOR MARKINGS:

- A. DESCRIPTION: This item shall govern for surface preparation of pavement surface areas prior to placement of pavement markings or raised pavement markers.
- B. MATERIALS: Abrasive blasting medium, when used, shall be a quality commercial product capable of producing the specified surface cleanliness without the deposition of deleterious materials on the cleaned surface. Water used in blasting operations shall be potable.
- C. EQUIPMENT: Equipment shall be in good condition. Air compression equipment shall utilize moisture and oil traps, in working order, of sufficient capacity to remove contaminants from blasting air and prevent the deposition of moisture, oil or other contaminants on the roadway surface.
- D. CONSTRUCTION METHODS: Widths, lengths and shapes of the prepared surfaces shall only be of sufficient size to include the full area of pavement markings or raised pavement markers shown on the plans.

Surface preparation of portland cement concrete surfaces shall be sufficient to remove contaminants. Damage to the roadway surface due to over-blasting shall be held to a minimum. Asphaltic pavement surfaces shall be cleaned by brushing, washing, compressed air, high pressure water or any combination thereof to remove all forms of contamination and loose materials. All other surfaces to be cleaned by blast cleaning shall be cleaned sufficiently to remove loose and flaking materials from the roadway surface.

When existing markings are encountered, they shall be cleaned sufficiently to remove all loose and flaking materials. Small spots of old markings or contaminants of up to 0.5 square inch in area may remain if the contaminant is not removed by the following test:

Firmly press a 10 inch long, two-inch wide strip of monofilament tape onto the surface to be tested, leaving approximately two inches (2") free. Grasp the free end and remove the tape with a sharp pull.

Blasting pressure and technique shall be controlled to prevent damage to the pavement surface. Portland cement concrete surfaces shall not be cleaned by grinding.

- E. MEASUREMENT AND PAYMENT: The work performed and material furnished in accordance with this item shall be considered subsidiary to unit prices bid for new pavement markings.

END OF SECTION