SPECIAL SPECIFICATION

8251

Reflectorized Pavement Markings with Retroreflective Requirements

1. **Description.** Furnish and place reflectorized pavement markings of the types, colors, sizes, widths, and thickness shown on the plans.

2. **Materials.**
   
   A. **Type I Marking Materials.** Furnish in accordance with Departmental Material Specification DMS-8220, “Hot Applied Thermoplastic.”
   
   B. **Type II Marking Materials.** Furnish in accordance with DMS-8200, “Traffic Paint.”
   
   C. **Glass Traffic Beads.** Furnish drop on glass beads conforming to DMS-8290, “Glass Traffic Beads.” When furnishing a combination of Type II and III, apply separately in equal portions (by weight) and apply Type III first.

   1. **Type I Markings.** Furnish drop on glass beads that are:
      
      - Type II or a combination of Type II and III, when applying markings at a thickness of 0.060 in. (60 mils);
      
      - Type II, Type III, or a combination of Type II and III, when applying markings at thicknesses greater than 0.060 in. (60 mils);
      
      - Type II on transverse markings such as stop bars, cross walks, or striping installed with hand line machines.

   2. **Type II Markings.** Furnish drop on glass beads that are Type II, Type III, or a combination of Type II and III, when applying Type II markings as final markings.

   D. **Labeling.** Use clearly marked containers that indicate color, mass, material type, manufacturer, and batch number.

3. **Equipment.**

   A. **General Requirements.** Use pavement marking application equipment that:
      
      - is maintained in satisfactory condition;
      
      - meets or exceeds the requirements of the National Board of Fire Underwriters and Texas Railroad Commission for this application;
      
      - uses an automatic bead dispenser attached to the pavement marking equipment;
      
      - can provide continuous mixing and agitation of the pavement marking material; and
• includes a hand-held thermometer capable of measuring the temperature of the marking material when applying Type I material.

Use a mobile retroreflectometer approved by the Construction Division and certified by the Texas Transportation Institute Mobile Retroreflectometer Certification Program.

Use a portable retroreflectometer that:
• uses 30-meter geometry and meets the requirements described in ASTM E 1710;
• has either an internal global positioning system (GPS) or the ability to be linked with an external GPS with a minimum accuracy rating of 16.4 ft. in accordance with the circular error probability (CEP) method (CEP is the radius of the circle with its origin at a known position that encompasses 50% of the readings returned from the GPS instrument);
• can record and print the GPS location and retroreflectivity reading for each location where readings are taken.

B. Material Placement Requirements. Use equipment that can place:
• a minimum of 40,000 ft. of 4-in. solid or broken markings per day at the specified thickness over five consecutive days;
• linear markings up to 8 in. wide in a single pass;
• markings other than solid or broken lines at an approved rate;
• a center-line and no-passing barrier-line configuration consisting of one broken line with two solid lines at the same time to the alignment, spacing, and thickness shown on the plans;
• white lines from both sides;
• lines with clean edges, uniform cross-section and thickness, and reasonably square ends;
• skip lines between 10 and 10 1/2 ft., an approximate stripe-to-gap ratio of one to three, and a stripe-gap cycle between 39 1/2 ft. and 40 1/2 ft.;
• beads uniformly and almost instantly upon the marking as the marking is being applied; and
• beads uniformly during the application of two adjacent lines. Each line must have an equivalent bead yield rate and embedment;
• Type II and Type III beads from separate bead applicators, when applying a combination of Type II and Type III beads.

4. Construction. Place markings before opening to traffic unless short-term or work zone markings are allowed.

A. General. Obtain approval for the sequence of work and estimated daily production.

Place markings on roadways already open to traffic with minimum interference to the operations of that roadway. Use traffic control as shown on the plans or as approved.
Protect all markings placed under open-traffic conditions from traffic damage and disfigurement.

Establish guides to mark the lateral location of pavement markings as shown on the plans or as directed and have guide locations verified. Use material for guides that will not leave a permanent mark on the roadway.

Provide markings with uniform and distinctive characteristics when observed in accordance with Tex-828-B. When minimum retroreflectivity requirements are specified, these values will be used to measure retroreflectivity performance.

Apply markings on pavement that is completely dry and passes the following tests:

1. **Type I Markings Application.** Place a sample of Type I marking material on a piece of tarpaper placed on the pavement. Allow the material to cool to ambient temperature and then observe the underside of the tarpaper in contact with the pavement. Pavement is dry if there is no condensation on the tarpaper.

2. **Type II Markings Application.** Place a 1 sq. ft., clear piece of plastic on the pavement and weigh down the edges. The pavement is dry if, after observation for 15 minutes, no condensation occurs on the underside of the plastic.

Apply markings:
- using dimensions, colors and at locations shown in the plans;
- in proper alignment with the guides without deviating from the alignment more than 1 in. per 200 ft. of roadway or more than 2 in. maximum;
- free of blisters and with no more than 5%, by area, holes or voids;
- with uniform cross section and thickness;
- with clean and reasonably square ends;
- that are reflectorized when observed in accordance with Tex-828-B for the entire performance period of 15 days and meet the minimum retroreflective requirements as specified in Section 4.D of this Special Specification; and
- using personnel skilled and experienced with installation of pavement markings.

Remove all applied markings that are not in alignment or sequence as stated in the plans or as stated in the specifications at your own expense in accordance with Item 677.

B. **Surface Preparation.** Unless otherwise shown on the plans, prepare surfaces in accordance with this section.

1. **Cleaning for New Asphalt Surfaces and Retracing of All Surfaces.** For new asphalt surfaces (less than 3 years old) and retracing of all surfaces, air-blast or broom the pavement surface to remove loose material, unless otherwise shown on the plans. A sealer for Type I markings is not required unless otherwise shown on the plans.

2. **Cleaning for Old Asphalt and Concrete Surfaces (Excludes Retracing).** For old asphalt surfaces (more than 3 years old) and all concrete surfaces, clean in...
accordance with Item 678, “Pavement Surface Preparation for Markings,” to remove curing membrane, dirt, grease, loose and flaking existing construction markings, and other forms of contamination.

3. **Sealer for Type I Markings.** For asphalt surfaces more than 3 years old or for concrete, apply a pavement sealer before placing Type I markings on locations that do not have existing markings, unless otherwise approved. The pavement sealer may be either a Type II marking or an acrylic or epoxy sealer unless otherwise shown on the plans. Follow the manufacturer’s directions for application of acrylic or epoxy sealers. When the sealer becomes dirty after placement, clean by washing or in accordance with Section 4.B.1, “Cleaning for New Asphalt Surfaces and Retracing of All Surfaces.” Place the sealer in the same configuration and color (unless clear) as the Type I markings unless otherwise shown on the plans.

C. **Application.** Apply markings on surfaces with a minimum surface temperature of 50ºF, when measured in accordance with Tex-829-B.

Apply markings during good weather unless otherwise directed. If markings are placed at Contractor option when inclement weather is impending and the markings are damaged by subsequent precipitation, the Contractor is responsible for all costs associated with replacing the markings if required.

1. **Type I Markings.** Apply within the temperature limits recommended by the material manufacturer. Note: if during a spray application, operations cease for 5 min. or longer, flush the spray head by spraying marking material into a pan or similar container until the material being applied is at the proper temperature for application.

Apply on clean, dry pavements (meeting moisture test described above).

Apply Type I markings with a minimum thickness of:

- 0.100 in. (100 mils) for new surface treatments involving Item 316 or Item 318;
- 0.060 in. (60 mils) for retraced pavement markings; or
- 0.090 in. (90 mils) for all other Type I markings.

The maximum thickness for Type I markings is 0.180 in. (180 mils). Measure the thickness of markings in accordance with Tex-854-B, Part I

2. **Type II Markings.** Apply markings at an application rate of 15–20 gal./mi. for a solid 4 in. line and same rate adjusted proportionally for other widths

D. **Retroreflective Requirements.** Meet the following minimum retroreflectivity values for edge line markings, center-line/no passing barrier-line, and lane lines when measured anytime after 3 days but not later than 10 days after application:

1. **Type I Markings.**
   - White markings: 250 millicandela per square meter per lux (mcd/m2lx)
2. **Type II Markings.**
   - White markings: 175 mcd/m²lx
   - Yellow markings: 100 mcd/m²lx

E. **Retroreflectivity Measurements.** Use a mobile retroreflectometer unless otherwise shown on the plans.

1. **Mobile Reflectometer Measurements.** Provide mobile measurements averages for every 0.1 miles unless otherwise specified or approved by the Engineer. Take measurements on each section of roadway for each series of markings (i.e. edge-line, center skip line, each line of a double line, etc.) and for each direction of travel. Take all measurements in the direction of traffic flow, except on broken centerline on two-way roadways, take measurements in both directions. Furnish measurements in compliance with Special Specification, “Mobile Retroreflectivity Data Collection for Pavement Markings,” unless otherwise approved by the Engineer. The Engineer may require an occasional field comparison check with a portable retroreflectometer meeting the requirements listed above to ensure accuracy. Use all equipment in accordance with the manufacturer’s recommendations and directions. Inform the Engineer at least 24 hours in advance of taking any measurements.

   If 30% or more of the average measurements fail within a one-mile segment, restripe once at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material or 15 to 20 gallons per mile of Type II marking material. Take measurements every 0.1 miles after 3 days but before 10 days of this second application within that mile segment for that series of markings. If 30 % or more of the average measurements fall below the minimum retroreflectivity requirements, restripe using 15 to 20 gallons per mile of Type II marking material at the Contractor's expense. If the markings do not meet minimum retroreflectivity after this application, the Engineer may require removal of all existing markings, a new application as initially specified, and a repeat of the application process until minimum retroreflectivity requirements are met. If the Engineer does not require removal of the markings, restripe using 15 to 20 gallons per mile of Type II marking material at the Contractor's expense until minimum retroreflectivity requirements are met.

2. **Portable Reflectometer Measurements.** When using a portable reflectometer, take a minimum of three measurements for each 1 mile section of roadway for each series of markings (i.e. edge-line, center skip line, each line of a double line, etc.) and for each direction of travel. Take all measurements in the direction of traffic flow, except on broken centerline on two-way roadways, take measurements in both directions. The spacing between each measurement must be at least 1000 ft. The Engineer may decrease the mileage frequency for measurements if the previous measurements provide satisfactory results. The Engineer may require the original number of measurements if concerns arise.
If two or more of the measurements taken on a specific series of markings within each mile segment fall below the minimum retroreflectivity values, take a minimum of five more measurements within that mile segment for that series of marking. If two or more of these measurements fail, restripe once at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material or 15 to 20 gallons per mile of Type II marking material. Take a minimum of five more measurements after 3 days but before 10 days of this second application within that mile segment for that series of markings. If two or more of these measurements fail below the minimum retroreflectivity requirements, restripe using 15 to 20 gallons per mile of Type II marking material at the Contractor's expense. If the markings do not meet minimum retroreflectivity after this application, the Engineer may require removal of all existing markings, a new application as initially specified, and a repeat of the application process until minimum retroreflectivity requirements are met. If the Engineer does not require removal of the markings, restripe using 15 to 20 gallons per mile of Type II marking material at the Contractor's expense until minimum retroreflectivity requirements are met.

3. Traffic Control. Provide traffic control, as required, when taking retroreflectivity measurements after marking application. On low volume roadways (as defined on the plans), refer to the figure, "Temporary Road Closure" in Part VI of the Texas Manual on Uniform Traffic Control Devices for the minimum traffic control requirements. For all other roadways, the minimum traffic control requirements will be as shown on the standard plans TCP (3-1) and TCP (3-2). The lead vehicle will not be required on divided highways. The traffic control plan and traffic control devices must meet the requirements listed in Item 502. Time restrictions that apply during striping application will also apply during the retroreflectivity inspections except when using the mobile retroreflectometer unless otherwise shown on the plans or approved.

F. Performance Period. All markings (and replacement markings) must meet all requirements of this Specification, except for Section D., “Retroreflective Requirements,” for a minimum of 15 calendar days after installation. Remove all pavement markings that fail to meet all requirements of this Specification and replace at the Contractor’s expense unless otherwise directed. Replace all failing markings within 30 days of notification.

5. Measurement. This Item will be measured by the foot. Double stripes will be measured separately.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2, “Plans Quantity Measurement.” Additional measurements or calculations will be made if adjustments of quantities are required.

Acrylic sealer, epoxy sealer, or Type II markings, when used as a sealer for Type I markings, will be measured as Pavement Sealer.

6. 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 with Retroreflective Requirements” of the types, colors, sizes, widths, and thickness (Type I markings only) specified or “Pavement Sealer” of the size specified. This price will be full compensation for furnishing all materials; application of pavement markings; retroreflective readings; traffic control; and other equipment, labor, tools, and incidentals.

Surface Preparation, when shown on the plans, will be paid for under Item 678.

Final work-zone pavement markings (Type II), which can be used as a sealer for Type I markings, will be paid for under this Item.

When replacement Type II markings are required due to damage to the original markings from rain, sleet, hail, etc., and the original markings were placed at the direction of the Department, the plan quantity requirements under “Measurement” do not apply to the original and replacement markings. The Contractor will be paid for the actual quantity of original and replacement markings at the unit bid price bid for that bid item.