

# Special Specification 6024

## High Performance 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

- 2.1. **Type I Marking Materials.** Furnish in accordance with Departmental Material Specification DMS-8220, "Hot Applied Thermoplastic."
- 2.2. **Type II Marking Materials.** Furnish in accordance with Departmental Material Specification DMS-8200, "Traffic Paint."
- 2.3. **Glass Traffic Beads.** Furnish drop-on glass beads to meet the desired performance requirements.
- 2.4. **Labeling.** Use clearly marked containers that indicate color, mass, material type, manufacturer, and batch number.

### 3. EQUIPMENT

- 3.1. **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 E1710;
- 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.

- 3.2. **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;
- beads uniformly during the application of two adjacent lines. Each line must have an equivalent bead yield rate and embedment; and
- different bead types with each bead type dispensed from separate bead applicators, when applying a double-drop of beads.

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## 4. CONSTRUCTION

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

### 4.1. **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:

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.

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; 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.

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

- 4.2.1. **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.
- 4.2.2. **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.
- 4.2.3. **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.
- 4.3. **Application.** Apply markings on surfaces with a minimum surface temperature of 50°F, 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.

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.

- 4.4. **Retroreflective Requirements.** Meet the following minimum retroreflectivity values for edge line markings, center-line/no passing barrier-line, and lane lines when measured any time after 30 days but not later than 40 days after application:
- White markings: 400 millicandelas per square meter per lux (mcd/m<sup>2</sup>lx)
  - Yellow markings: 250 mcd/m<sup>2</sup>lx
- 4.5. **Retroreflectivity Measurements.** Use a mobile retroreflectometer unless otherwise shown on the plans.
- 4.5.1. **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 traffic flow. For centerlines on two-way roadways measure each line in both directions (i.e. measure both double solid lines in both directions and measure all centerskip lines 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.

A marking meets the retroreflectivity requirements if;

- the combined average retroreflectivity for a one-mile segment meets the minimum values specified in 8999.4.D Retroreflective Requirements, and
- no more than 30 percent of the values are below the minimum level within the one mile segment.

The Engineer may accept one-mile segments whose average falls below the minimum specified but no more than 20 percent of the values within that mile segment are below the minimum level such that if the less-than-minimum values were discarded the segment average would subsequently pass the specified minimum values.

The one mile segment will start from the beginning of the data collection and end after a mile worth of measurements have been taken; each subsequent mile of measurements will be a new segment. Centerlines with two stripes (either solid or broken) will result in 2 miles of data for each mile segment. Each centerline stripe shall be tested for compliance as a stand-alone stripe.

If the marking fails these retroreflectivity requirements, restripe at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking. Take measurements every 0.1 miles after a minimum of 10 days after this second application within that mile segment for that series of markings.

If the markings do not meet minimum retroreflectivity after 10 days after this second 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.

4.5.2. **Portable Reflectometer Measurements.** When using a portable reflectometer, take a minimum of 20 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 traffic flow. For centerlines on two-way roadways measure each line in both directions (i.e. measure both double solid lines in both directions and measure all centerskip lines in both directions). The spacing between each measurement must be at least 100 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 the average of these measurements fails, restripe once at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material. Take a minimum of 10 more measurements after 10 days of this second application within that mile segment for that series of markings. If the average of these measurements fall below the minimum retroreflectivity requirements, restripe again at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material. If the markings do not meet minimum retroreflectivity after this third 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.

4.5.3. **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.

4.6. **Performance Period.** All markings must meet the requirements of this Specification for a minimum of 30 calendar days after installation. Remove all pavement markings that fail to meet the requirements of this Specification and replace at the Contractor's expense unless otherwise directed. Replace all failing markings

within 30 days of notification. All replacement markings must also meet all requirements of this Specification for a minimum of 30 calendar days after installation.

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**5. MEASUREMENT**

This Item will be measured by the linear 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.

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**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 "High Performance Pavement Markings with Retroreflective Requirements" of the types, colors, sizes, widths, and thickness 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.