

**SPECIAL PROVISION**

**REGARDING**

**PERFORMANCE BASED PAVEMENT MARKING INSTALLATION**

**Scope**

This provision covers the retroreflective luminance (retroreflectivity) requirements and testing methods used to determine the acceptability of installed performance-based traffic markings.

**Retroreflectivity**

Retroreflectivity in pavement markings is a measure of the amount of light from the vehicle's headlamps that is reflected back to the driver's eyes. In mathematical terms, it is a ratio of the reflected luminance to the headlamp illuminance at a certain viewing geometry.

The coefficient of dry retroreflective luminance shall be a minimum of 300 mcd/lux/sq m for white stripe and a minimum of 200 mcd/lux/sq m for yellow stripe

**Material Requirements**

All retraced pavement markings shall consist of the type designated in the Special Notes.

Performance Based spray thermo pavement markings (40 mil minimum thickness) and painted markings shall meet the minimum retroreflective values as stated above.

As a minimum, Performance Based spray thermoplastic pavement marking materials shall meet or exceed the material and physical requirements in the Standard Specifications for Road and Bridge Construction 2021, Section **716.03**. For drop on glass beads, a one-quart sample shall be submitted to headquarters Materials and Tests for gradation and lead and arsenic evaluation. Supplier, contract, and lot numbers must be provided with each submittal. Performance Based painted pavement markings shall meet or exceed the material and physical requirements in the Standard Specifications for Road and Bridge Construction 2021, Section **910.02**. For drop on glass beads a one-quart sample shall be submitted to headquarters Materials and Tests for gradation and lead and arsenic evaluation. Supplier, contract, and lot numbers must be provided with each submittal. Drop on glass beads and their application rate shall be selected by the Contractor to meet the above retroreflective requirements after a minimum of 45 days wear on the installed traffic markings. Beads shall be applied uniformly across the entire line width to an embedment of 50-60% of the bead diameter.

**Testing Requirements**

Retroreflectivity values (RL) shall be measured in mcd/lux/sq m using a mobile Delta LTL-M retroreflectometer. Each retroreflectivity value recorded may be referred to as a measurement, a reading, or a test. A test, however, may also be a calculated value of measurements or reading values from multiple segments. Only readings made by the Department representative with a calibrated LTL-M retroreflectometer will be used in determining compliance with the retroreflectivity requirements and payment calculations.

To facilitate the retroreflective measurement process, both colors on every route in a county are to be completed before beginning the marking in another county. Short sections of routes that enter another county may be marked at the same time as the current county if approved by the Engineer. Furthermore, yellow and white markings shall be tested and approved as separate quantities.

The Contractor shall provide the Engineer with Daily Work Reports using State Form DT-1296 Performance Paint Report to detail the work performed by each marking machine used each day. A copy of the approved and accepted DT-1296 form shall be provided to the Contractor at the pre-construction conference. Each report submitted to the Engineer by the Contractor shall provide, at minimum, the following information: county name; route number; marking limits per route; marking material applied and application rate; reflective beads applied and application rate; direction of application; and weather conditions.

The Engineer shall begin collecting retroreflectivity measurements approximately 45 calendar days after work has been completed in a county. The retroreflectivity measurements shall be completed within approximately 30 days. In an effort to have an open testing environment, the Contractor is encouraged to be present, courteous, and professional during retroreflectivity testing conducted under this contract. Should the Contractor elect to participate in testing operations conducted under this contract the Contractor will be notified approximately 48 hours before planned retroreflectivity testing begins in a county. The Contractor's preference for notification, either by phone or email, shall be established or agreed upon in the Pre-construction Conference. The notification will include information regarding scheduling, establishing a rendezvous point for the testing team, weather forecast, and contingencies. It shall be the Contractor's responsibility, should he desire to participate, to meet the Engineer or his representative at the agreed-upon time and location. Testing shall be conducted as planned and at the Engineers discretion should the Contractor fail to appear. The privilege of accompanying the testing team may be rescinded if the Contractor's representatives do not conduct themselves in a cooperative, courteous, and helpful manner.

**Testing Procedures**

LTL-M retroreflectometer testing shall be conducted where retracing has been performed and shall include the entire route in each county. All readings shall be made in the direction of placement. The readings will be taken on the center of each line on the route. The line may be divided into segments at the discretion of the Engineer. Each segment will be assigned an acceptance factor based on the average retroreflectivity measured by the LTL-M as shown in Table 1. An average retroreflectivity value will be calculated for each line on the route in each county (see Equation 1). For retraced markings which contain profiled rumbles and/or rumble stripes, the same procedure will be followed.

Retroreflectivity for each color (white or yellow) will be measured separately to determine if a segment meets the retroreflectivity requirements set forth in this contract. A site acceptance factor for each segment will be determined using the Table 1.

White	Yellow	Site Acceptance Factor, A
RL ≥ 300	RL ≥ 200	1.0
300 > RL ≥ 290	200 > RL ≥ 190	0.8
290 > RL ≥ 270	190 > RL ≥ 180	0.5
270 > RL ≥ 255	180 > RL ≥ 170	0.3
RL < 255	RL < 170	0.0

Table 1: Site Acceptance Factor for Ranges of Retroreflective Luminance (RL)

Portions of the retroreflective data may be removed at the Engineers discretion when encountering contaminated lines or any other condition affecting line performance beyond the control of the Contractor. In the event markings are placed after the designated completion date as defined in the Special Notes, no adjustments will be made for damage done by snowplows or other equipment due to winter operations at the time of testing.

For retraced markings on non-paver placed mixes, such as chip seals, the markings shall be inspected and accepted visually by the Engineer.

### **Reporting**

The acceptance testing reports by TDOT shall include the following:

- Date and time of application of pavement marking (information taken from the Contractor's daily work report);
- The direction of placement;
- The description of the instrumentation;
- Test date and time;
- The location of the measurement (BLM, ELM);
- The color of line being tested;
- The type of line being tested (edge, skip, center);
- Recorded average reflectivity in millicandelas per square meter per lux (mcd/lux/sq m).

### **Method of Measurement**

The conditionally accepted quantity of Pavement Markings shall be measured in accordance with Subsection **716.08** of the Standard Specifications for Road and Bridge Construction.

### **Basis of Payment**

Conditionally accepted quantities of reflective markings will be paid for at the contract unit price which shall be full compensation for cleaning and preparing the pavement surface, furnishing, and placing all materials including labor, tools, equipment, and incidentals necessary to complete the work. Based on the continuance of work by the Contractor within a county all conditionally accepted marking quantities will be paid on the current engineers estimate. A minimum of one marking crew working in a county shall be required to fulfill the continuance of work described above. Following completion of retroreflectivity testing in a county, a Low Performance Deduction will be calculated using the equation below for markings of each color and pay item combination. The sum of the Low Performance Deductions will be deducted from monies due the contractor on the next Engineer's Estimate.

Equation 1:

$$LPD = \left[ 1 - \frac{\sum A}{n} \right] M$$

Where:

$LPD$  = Low-Performance Deduction

$\sum A$  = Sum of site acceptance factors =  $A_1 + A_2 + \dots + A_n$

$n$  = Number of segments for the route

$M$  = Total line miles