

## **INTEGRATED MULTI-POLYMER PAVEMENT MARKINGS (REV 12-17-20)**

The following new Section is added:

### **SECTION 712 INTEGRATED MULTI-POLYMER PAVEMENT MARKINGS**

#### **712-1 Description.**

Apply new Integrated Multi-Polymer (IMP) pavement markings to portland cement concrete pavement in accordance with the Contract Documents.

#### **712-2 Materials.**

**712-2.1 Integrated Multi-Polymer:** Use only material approved by the Department for use on projects covered by this Developmental Specification.

Use materials meeting the requirements of 971-1 (with the exception of 971-1.4) and Dev971IMP.

**712-2.2 Glass Spheres:** Use only glass spheres meeting the requirements of 971-1 and 971-2 and are listed on the Approved Product List (APL). The Engineer will take random sample of all glass spheres in accordance with ASTM D1214 and the Department's Sampling, Testing, and Reporting Guide Schedule.

#### **712-3 Equipment.**

Use equipment capable of producing varying width IMP pavement markings and that meets the following requirements:

1. Equipped with a kettle for that provides uniform heating and melting of marking materials to temperatures exceeding 390°F, and mixing and agitation of the material reservoir to provide a homogenous mixture without segregation. The kettle must be equipped with and automatic temperature control device and material thermometer for positive temperature control and to prevent overheating or scorching of the pavement marking material. Equipment must be capable of maintaining the marking material in a molten state, in all mixing and conveying parts, including the line dispensing device until applied.
2. Capable of following straight lines and making normal curves in a true arc and traveling at a uniform, predetermined rate of speed, both uphill and downhill, in order to produce a uniform application of marking material.
3. Capable of applying glass spheres to the surface of initial pavement markings by a double drop application, and the surface of recapped/refurbished markings by a single drop application. Attach the bead dispenser for the first bead drop to the striping machine so that the beads are dispensed closely behind the application of the pavement marking material. Attach the second bead dispenser bead to the striping machine so that the beads are dispensed immediately after the first bead drop application. Glass spheres dispensers must be equipped with an automatic cut-off control that is synchronized with the cut-off of the pavement marking material and applies the glass spheres in a manner so that the spheres appear uniform on the entire marking with 50 to 60% embedment.

4. Meets the requirements of the National Fire Protection Association, State, and local authorities.

#### **712-4 Application.**

**712-4.1 General:** Remove existing pavement markings using hydroblasting.

Before applying IMP pavement markings, remove any material that would adversely affect the bond of the markings by a method approved by the Engineer and apply a two-part epoxy primer in accordance with the manufacturer's recommendations. Apply primer at approximately 25 wet mils. Protect the primer from contact by traffic and allow to dry to a slightly tacky state prior to the application of the pavement marking material. Offset longitudinal lines at least 2 inches from any longitudinal joints.

Apply pavement markings only to clean dry surfaces when the ambient air and wind chill temperature is at least 50°F and rising at the time of actual application. Failure to comply with temperature specifications can lead to premature bond failure.

Apply pavement markings using the dimension and alignment tolerances specified in 710-5.

Conduct field tests in accordance with FM 5-541. Take test readings representative of the marking performance. Remove and replace pavement markings not meeting the requirements of this Section at no additional cost to the Department.

Apply all final pavement markings prior to opening the road to traffic.

**712-4.2 Material Application Surfaces:** Clean and remove curing compound by shot blasting, sand blasting, or hydroblasting. Obtain the Engineer's approval for all pavement surface preparation methods prior to implementing. Completely remove all curing compound and surface laitance from pavement surface areas where IMP pavement markings will be placed. The pavement surface must be free of grease, oil, mud, dust, dirt, grass, loose gravel, laitance residue and other deleterious materials prior to applying the pavement marking.

Prepare the pavement surface, including removal of curing compound, a minimum of two inches wider than the pavement markings to be placed, such that one inch of prepared area is on all sides of the pavement markings after they are applied.

Immediately prior to the application of the two-part epoxy primer, blow the pavement surface clean by compressed air to remove residue or debris.

Perform all pavement surface preparation, including curing compound removal, so that pavement or joint material is not damaged or left in a condition that will mislead or misdirect the motorist. Repair any damage to the pavement or joint materials caused by surface preparation by acceptable methods. Where pavement surface preparation results in obscuring existing pavement markings of a lane occupied by traffic, immediately remove the residue, including dust, by approved methods.

**712-4.3 Thickness:** Apply IMP pavement markings for longitudinal lines to attain a minimum thickness of 0.10 inch or 100 mils and a maximum thickness of 0.15 inch or 150 mils when measured above the pavement surface.

Measure, record, and certify on Department approved forms and submit to the Engineer, the thickness of white and yellow pavement markings in accordance with FM 5-541.

The Engineer will verify the thickness of the pavement markings within 30 days of receipt of the Contractor's certification.

**712-4.4 Retroreflectivity:** Apply white and yellow IMP pavement markings that will attain an initial retroreflectivity of not less than 450 mcd/lx·m<sup>2</sup> and not less than 350 mcd/lx·m<sup>2</sup>,

respectively for all longitudinal lines. Black pavement markings must have a retroreflectance of less than 5 mcd/lx·m<sup>2</sup>.

Measure, record and certify on Department approved form and submit to the Engineer, the retroreflectivity of white and yellow pavement markings in accordance with FM 5-541.

**712-4.5 Glass Spheres:** For initial IMP pavement markings, apply the first drop of Type 4 spheres immediately followed by the second drop of Type 1 glass spheres. Apply reflective glass spheres to all markings at the rate determined by the manufacturer's recommendations.

#### **712-5 Contractor's Responsibility for Notification.**

Notify the Engineer prior to the placement of the IMP pavement marking materials. At the time of notification, submit a certification to the Engineer with the manufacturer's name and batch numbers of the pavement marking materials and glass spheres to be used.

#### **712-6 Protection of Newly Applied Pavement Markings.**

Do not allow traffic onto or permit vehicles to cross newly applied IMP pavement markings until they are sufficiently dry. Remove and replace any portion of the pavement markings damaged by passing traffic or from any other cause, at no additional cost to the Department.

#### **712-7 Observation Period.**

IMP pavement markings are subject to a 180-day observation period under normal traffic. The observation period shall begin with the satisfactory completion and acceptance of the work.

The pavement markings shall show no signs of failure due to blistering, excessive cracking, chipping, poor adhesion to the pavement, or loss of reflectivity. The retroreflectivity shall meet the initial requirements of 712-4.4

The Department reserves the right to check the retroreflectivity any time prior to the end of the observation period.

Replace, at no additional expense to the Department, any pavement markings that do not perform satisfactorily under traffic during the 180-day observation period.

#### **712-8 Corrections for Deficiencies.**

Recapping applies to conditions where additional pavement marking material is applied to new or refurbished pavement markings to correct a deficiency. Correct deficiencies with additional marking material or by complete removal and reapplication of a one mile section centered around the deficiency, as determined by the Engineer, at no additional cost to the Department.

If recapping will result in a thickness exceeding the maximum allowed, the pavement markings will be removed and reapplied.

#### **712-9 Submittals.**

**712-9.1 Submittal Instructions:** Prepare a certificate of quantities, using the Department's current approved form, for each project in the Contract. Submit the certification of quantities and daily worksheets to the Engineer. The Department will not pay for any disputed items until the Engineer approves the certification of quantities.

**712-9.2 Contractor's Certification of Quantities:** Request payment by submitting a certification of quantities no later than Twelve O clock noon Monday after the estimate cut-off date or as directed by the Engineer, based on the amount of work done or completed. Ensure the certification of quantities consist of the following:

1. Contract Number, FPID Number, Certification Number, Certification Date and the period that the certification represents.

2. The basis for arriving at the amount of the progress certification, less payments previously made and less any amount previously retained or withheld. The basis will include a detailed breakdown provided on the certification of items of payment.

**712-10 Method of Measurement.**

The quantity to be paid for under this Section will be the length, in gross miles, of solid, 10'-30' skip, 2'-4' dotted, 6'-10' dotted, or 3'-9' dotted lines. The gross mile measurement will be taken as the distance from the beginning of the thermoplastic line to the end of the thermoplastic line and will include the unmarked gaps for skip and dotted lines. The gross mile measurement will not include designated unmarked lengths at intersections, turn lanes, etc. Final measurement will be determined by plan dimensions or stations, subject to 9-1.3.1.

No separate payment to be made for hydroblasting, whether for pavement surface preparation or removing existing pavement markings. Include cost for hydroblasting in payment for IMP pavement markings.

**712-11 Basis of Payment.**

Price and payment will be full compensation for all work specified in this Section, including, all cleaning and preparing of surfaces, furnishing of all materials, application, curing and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work. Final payment will be withheld until all deficiencies are corrected.

Payment will be made under:

Item No. 918- 712- Integrated Multi-Polymer Pavement Markings

Solid - per gross mile.

Skip - per gross mile.

Dotted - per gross mile.

**PAVEMENT MARKING MATERIALS – INTEGRATED MULTI-POLYMER MATERIALS**  
**(REV 12-17-20)**

SECTION 971 is expanded by the following new ARTICLE:

**971-11 Integrated Multi-Polymer Material.**

**971-11.1 General:** Integrated multi-polymer pavement marking material shall meet the general requirements of 971-1, with the exception of 971-1.1 and 971-1.4, and the additional requirements of this Specification.

The material shall be homogeneously composed of pigments, resins, polymers (adhesive constituent), glass spheres, and other fillers. The material shall meet the following requirements:

1. Readily extrude at temperatures of 400°F to 425°F, not to exceed 450°F, using equipment meeting the requirements of Section 712.
2. Not exude fumes that are toxic or injurious to people or property when heated to the application temperature.
3. When cooled to normal pavement temperature, materials shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic.

The material shall be available in white, yellow, and black from the same manufacturer. The manufacturer shall have the option of formulating the material according to their own specifications. However, the requirements delineated in this Specification and Section 712 shall apply regardless of the type of formulation used.

**971-11.2 Packaging and Labeling:** The material shall be packaged in suitable thermo-degradable containers which will not adhere to the product during shipment and storage. Each package shall be clearly labeled with name and address of the manufacturer, color, date of manufacture, and lot number. The label shall warn the user that the material shall be heated in the range as recommended by the manufacturer. The container of material shall weigh approximately 50 pounds.

**971-11.3 Composition:**

Component	Test Method	White	Yellow	Black
Glass Spheres	ASTM D4797	46% minimum	46% minimum	n/a
TiO <sub>2</sub> , Type II Rutile		10% minimum	n/a	n/a
Organic Yellow		n/a		n/a
Resin Polymer Content	ASTM D4797	21% - 26%	21% - 26%	21% - 26%
Inert Fillers		16% - 21%	26% to 31%	n/a

**971-11.4 Glass Spheres:** Glass spheres shall meet the requirements of 971-2. The glass spheres in the intermix shall consist of 50% Type 1 and 50% Type 3.

Sieve Size (US Mesh)	Percent Passing
20	100%
50	0% - 10%

**971-11.5 Physical Properties:** Laboratory samples shall be tested in accordance with ASTM D7307 and ASTM D7308 and meet the following criteria:

Property	Test Method	Minimum	Maximum
Specific Gravity	Water displacement		2.15
Bond Strength	ASTM D4796 or ASTM C321	300 psi	
Low Temperature Stress (Cracking)	AASHTO T250 <sup>(1)</sup>	No cracking	
Gardner Impact (Room Temperature)	ASTM D5420, Section 11 <sup>(2)</sup>	60 inch-pounds	
Gardner Impact (Low Temperature)	ASTM D5420, Section 11 <sup>(3)</sup>	10 inch-pounds	
Tensile Elongation	ASTM D638 <sup>(4)</sup>	30%	
Taber Abrasion	ASTM D4060 <sup>(5)</sup>		350 mg
Flash Point	ASTM D92	500°F	

1. 72-hour freeze cycle at 15 degrees F at an application thickness of 125 mils on concrete.  
2. Tested at 73.4°F, plus or minus 3°F on a concrete substrate applied at 125 mils using a 2# weight and a 0.625-inch male indenter.  
3. Tested at 32°F, plus or minus 3°F on a concrete substrate applied at 125 mils using a 2# weight and a 0.625-inch male indenter.  
4. Type “dog bone” configuration of a width of approximately 0.45 inches and a thickness of 0.10 inches (100 mils) with a pull rate shall be 0.25 inches per minute.  
5. At 1000 cycles using CS 17 wheels with a 1,000-gram load. Test specimens shall be conditioned at room temperature for 72 hours before testing.

**971-11.6 Set to Bear Traffic:** When applied at a temperature range of 412.5°F, plus or minus 12.5°F, and at a thickness of 0.90 inch or 90 mils to 0.125 inch or 125 mils, the material shall set to bear traffic in not more than two minutes when the pavement surface temperature is 50°F, plus or minus 3°F, and not more than ten minutes when the pavement surface temperature is 130°F, plus or minus 3°F.

**971-11.7 Retroreflectivity:** The white and yellow pavement markings shall attain an initial retroreflectance of not less than 450 mcd/lx·m<sup>2</sup> and not less than 350 mcd/lx·m<sup>2</sup>, respectively. The markings shall retain a minimum retroreflectance for two years of not less than 300 mcd/lx·m<sup>2</sup> for white and not less than 250 mcd/lx·m<sup>2</sup> for yellow. The retroreflectance of the white and yellow markings at the end of the five-year service life shall not be less than 150 mcd/lx·m<sup>2</sup>. Black pavement markings must have a retroreflectance of less than 5 mcd/lx·m<sup>2</sup>.

**971-11.8 Application Properties:** Application properties shall meet the requirements of Section 712.