DS-23090
(Replaces DS-23069)

DEVELOPMENTAL SPECIFICATIONS FOR MULTI-COMPONENT LIQUID PAVEMENT MARKINGS

Effective Date
July 21, 2026

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

23090.01 DESCRIPTION.

Provide reflectorized white and yellow multi-component, 100% solids liquid pavement markings that are free of toxic heavy metals for installation on asphalt and PCC pavement surfaces.

23090.02 MATERIALS.

A. General.

1. Apply multi-component liquid pavement markings in accordance with Article 2527.01 of the Standard Specifications.

2. Use materials capable of producing pavement markings with a wet-film thickness (WFT) of at least 20 mils. Apply at a greater WFT as recommended by the material manufacturer based on pavement type, pavement composition, environmental conditions, placement within a rumble, and other relevant factors. Approved products are listed in Materials I.M. 483.04, Appendix B. The Contractor may propose an equivalent product meeting all requirements of this specification, but the Engineer reserves the right to approve or deny the proposal. Multi-component Polyurea products will not be considered for usage.

3. Provide materials in accordance with the retro reflectivity requirements below.

Table 23090.02-1: Minimum Initial ~~Coefficient of Retroreflected Luminance~~ Retroreflectivity of Multi-Component Liquid Pavement Markings

Marking Type	Minimum Coefficient of Retroreflected Luminance (mcd/m2/lx)
White lines	~~400 mcd/sq. m/lux~~ 500
Yellow lines	~~250 mcd/sq. m/lux~~ 400

4. Provide yellow markings distinguishable from white markings in the dark.

5. Mix individual components before use if stored for more than 12 months.

B. Multi-Component Liquid Material.

1. Provide multi-component liquid material meeting the following requirements and characteristics:
   - **a.** Composed only of multi-component liquids and pigments,
   - **b.** Does not emit or leach solvents into the environment upon application to a pavement surface,
   - **c.** The infrared spectrum for all components shall match the reference sample provided by the manufacturer for the product tested and approved by the Department,
   - **d.** Free of lead, cadmium, mercury, hexavalent chromium, and other toxic heavy metals as defined by the EPA,
   - **e.** White material no darker than or no yellower than 17778 of Federal Standard Number 595C Colors,
   - **f.** Daytime color of the yellow epoxy meeting the following CIE chromaticity limits using illuminant “D65/2”:

Table 23090.02-2: Daytime Chromaticity Coordinates (Corner Points) - Yellow

	1	2	3	4
x	0.470	0.485	0.520	0.480
y	0.440	0.460	0.450	0.420

   - **g.** White daylight directional reflectance (Y) of least 83%,
   - **h.** Yellow daylight directional reflectance (Y) of at least 50%,
   - **i.** Nighttime color of yellow meeting the following chromaticity limits in ASTM D 6628:

Table 23090.02-3: Nighttime Chromaticity Coordinates (Corner Points) - Yellow

	1	2	3	4
x	0.575	0.508	0.473	0.510
y	0.425	0.415	0.453	0.490

   - **j.** Contrast ratio of 0.98 or greater when measured on a black/white drawdown card at 15 mils WFT application rate.

2. Provide shadow lane line markings (legend BLC6) according to Standard Road Plans PM-110 and PM-320. Black epoxy should satisfy color chip 37038 of Federal Standard 595B and have similar quality as the white and yellow multi-component pavement markings. An anti-skid material shall be incorporated with the shadow line marking at a minimum rate of 15 pounds per gallon.

3. **Adhesion Capabilities.**
   Provide material meeting the adhesion requirements of the ACI Committee 403 when tested on PCC. Apply multi-component liquid pavement markings during the test to concrete pavements with a tensile strength of at least 300 psi and ensure the failure of the system occurs in the concrete during testing.

4. **Abrasion Resistance.**
   Provide material with an abrasion resistance wear index no greater than 82 when tested in accordance with ASTM C 501 with a CS 17 wheel under a load of 1000 g for 1000 cycles. The Department defines the wear index as the weight in milligrams of material abraded from the sample under the test conditions.

5. **Hardness.**
   Provide material with a Type D durometer hardness from 75 to 90 when tested in accordance with ASTM D 2240 after curing for 72 hours at 73°F ±4°F.

6. **Tensile Strength.**
   For epoxy-amine based multicomponent systems, including variations of this base chemistry, provide material with a tensile strength of at least 6000 psi when tested in accordance with ASTM D 638 after curing for 72 hours at 73°F ±4°F.

7. **Compressive Strength.**
   For epoxy-amine based multicomponent systems, including variations of this base chemistry, provide material with a compressive strength of at least 12,000 psi when tested in accordance with ASTM D 695 after curing for 72 hours at 73°F ±4°F.

C. Retroreflective Media.

1. Provide first drop wet media per the minimum rate shown for each product below. Use one of the following products for all grooved: edge lines, white broken lines, ramp edge lines, and lane drop lines:
   - 3M Connected Roads All Weather Elements Series 70E or 50E: Minimum rate 5 pounds per gallon
   - Potters VisiUltra 455: Minimum rate 8 pounds per gallon

2. Provide second drop glass spheres in accordance with Specification 4184 of the Standard Specifications on all lines except for black broken lane lines.
   a. Glass spheres shall be dual coated.
   b. Apply glass spheres at a minimum rate of 15 pounds per gallon. Application rate shall provide required minimum levels of retro reflectivity in accordance with Table 23090.02-1.

3. Provide beads packaged in moisture-proof, multi-wall shipping bags, and in containers marked with the following information:
   a. Manufacturer name,
   b. Manufacturer address,
   c. Type of treatment,
   d. Batch number, and
   e. Date of manufacture.

D. Sampling and Testing.

1. Test daylight directional reflectance and color meeting the requirements of ASTM E 1349.

2. Provide 1 pint samples of each manufacturer's lot or batch of material when manufactured to an independent lab for this testing. NTPEP data may be substituted if the product has not changed from initial submittal to NTPEP for evaluation of these products.
3. Submit to the Engineer a manufacturer's Certificate of Compliance for all components of the multi-component liquid pavement marking system.

4. Mark containers with the following information:
   a. Name of manufacturer,
   b. Product identification number,
   c. Lot or batch number,
   d. Date of manufacture,
   e. Color, and
   f. Net weight of contents.

23090.03 CONSTRUCTION.

A. General.

1. The contract documents will specify quantity, locations, and type of pavement markings

required.

2. Use truck-mounted equipment designed for the preparation and application of multicomponent liquid pavement marking materials.

3. Beginning January 1, 2027, provide a minimum of one employe on the project holding an ATSSA Pavement Marking Technician certification and experience in the application of multicomponent liquid pavement markings. Employee(s) shall be on site at all times when multicomponent liquid pavement markings are being applied, with their primary attention being devoted to the surface preparation and pavement marking operations.

4. Provide a letter of certification from the pavement marking manufacturer indicating the Contractor's qualifications to install their product. The letter must be signed by an official from marking manufacturer and the date of the signature must be within the previous twelve months. Include a copy of the manufacturer's application instructions enclosed with the letter and have a copy available at all times on site for reference by the Engineer upon request.

5. Before beginning pavement marking operations, at a location approved by the Engineer, complete a 300 foot test section application of multicomponent liquid pavement markings that demonstrates the ability to meet the requirements of this specification. Do not begin pavement marking operations until the Engineer approves the test strip. The Engineer may waive the test strip requirement if they have sufficient evidence to ensure the crew will perform a quality application.

6. ~~2.~~ Allowable painting dates will be from April 8th to October 22nd. Minimum pavement surface and air temperatures for application of pavement markings shall be 40°F and rising.

7. ~~3.~~ For all pavement markings, ensure pavement surface is dry and free from dirt, dust, oil, curing compound, and other contaminates which may interfere with markings properly bonding to the surface by using both compressed air sprays and a power broom ahead of the application truck. Ensure the clean surface is at least 1 inch wider than anticipated marking. Shoot an air blast on the pavement surface immediately prior to placing new marking. Air blast is not intended to remove large amounts of dust, but only a very small amount of residue that might be left from removal and cleaning operation.

8. ~~4.~~ For pavement markings placed on a new ~~asphalt~~ pavement surface, install any necessary temporary pavement markings, and wait a minimum of 2 weeks from the day the surface is completed before installing permanent markings.

9. ~~5.~~ Remove existing multi-component pavement markings prior to new pavement marking placement by vacuum blasting, vacuum dry grinding, wet grinding, shot blasting, or high-pressure water blasting. Containment is required if open abrasive blasting or dry grinding is utilized. Do not utilize chemical removal methods for removal of the existing marking. It is the intent that existing markings be approximately 90% removed while not creating a groove deeper than 0.080 inches ±0.010 inches. Confirm with Engineer that proper removal is achieved prior to new pavement marking placement. If consensus on removal is not confirmed or achieved, consult with manufacturer of the pavement marking to be placed and verify they concur with adequate existing marking removal. Provide this concurrence info to the Engineer prior to beginning new pavement marking placement.

10. ~~7.~~ Ensure the following for all painted pavement markings:
    - Uniform thickness,
    - Uniform distribution of glass beads throughout the line width,
    - Minimum ~~L~~line widths as specified, ~~with a tolerance of ± 1/2 inch for all lines,~~ or a maximum of 1/2 inch above the specified width,

- Markings have sharp edges and cutoffs at the ends,
- Black contrast markings are no closer than 2 inches and no farther than 4 inches from the adjacent markings, and that the entire marking is applied within the grooved area, and
- Location and alignment are consistent with contract document requirements.

11. Take a minimum of ten width measurements per mile, per line, per color, spaced approximately 500 feet apart, for each line and each color. Report these values and locations to the Engineer at the end of each working day. The Engineer may perform additional width checks at their discretion. All measurements taken may be used to determine conformance with marking width requirements.

12. Take a minimum of three length measurements within the first 1000 feet of pavement markings applied each day, for each non-continuous line and each color. Measure both the length of each stripe, the gap between adjacent stripes of differing colors, and the gap between each set of stripes to ensure they are in conformance with the contract documents and Standard Road Plan PM-110. Report these values and locations to the Engineer at the end of each working day. The Engineer may perform additional length checks at their discretion. All measurements taken may be used to determine conformance with marking length requirements.

13. ~~6.~~ Limitations.

a. Complete grooving, existing pavement marking removal, and pavement marking placement in the same direction of travel as traffic is intended to utilize the lanes being worked on. On multi-lane roadways with adjacent lanes open to traffic, do not operate equipment against the flow of traffic.

b. When grooves are present, match existing cycle lengths for all non-continuous lines unless otherwise noted in the plans. If existing cycle lengths are found to differ from those specified in the contract documents by more than 10%, immediately cease work and consult the Engineer for direction.

B. Grooving.

1. Perform grooving according to Article 2527.03, H of the Standard Specifications and Standard Road Plan PM-115.

2. Grooving is intended to provide a recessed surface for placement of the new pavement marking. Grooving is also intended to remove any existing markings where the new installation of pavement markings is to occur. If existing cycle lengths are found to differ from those specified in the contract documents such that the grooving operation does not remove at least 75% of each line segment, immediately cease work and consult the Engineer for direction. Failure to notify the Engineer will result in the removal of excess existing markings being considered incidental to the grooving operation.

C. Traffic Control.

Apply the provisions of Section 2528 of the Standard Specifications to traffic control for removing and placing painted and taped pavement markings, along with the following additional requirements:

1. All work shall take place under static lane closures. Place traffic control devices on the roadway before removal operations have commenced. Leave traffic control devices in place through the completed curing time of the newly applied pavement markings.

2. Do not close any longer length of lane than can be adequately removed and replace in a single working day.

3. For painted pavement markings, do not remove traffic control devices until the newly applied pavement markings are tack free.

D. Final Inspection

If Mobile Reflectometer Measurements are an item on the contract, perform final inspection in accordance with the Developmental Specifications for Mobile Reflectometer Measurements. If that item is not on the contract, ~~P~~provide an acceptable, calibrated 30-meter geometry (100 feet), retro reflectometer to use on the project which will remain the property of the Contractor. In the presence of the Engineer, measure the retro-reflectivity of the pavement markings. Take a minimum of five randomly spaced readings per line type every 1 mile. The average minimum retro-reflectivity per mile shall be as per table 1 from Article 23090.02, A, 3.

E. Defective Pavement Markings and Grooves.

~~1. Markings that are low on initial retro reflectivity up to 20% may, at the discretion of the Engineer, be accepted with a price adjustment.~~

1. ~~2.~~ Repair, at no additional cost to the Contracting Authority, all pavement markings which, after application and curing, the Engineer determines to be defective and not in conformance with ~~these specifications~~ the contract documents. Remove the defective markings completely and clean ~~to~~ the underlying pavement surface according to the requirements of Article 2527.03, C of the Standard Specifications. Remove the defective area plus all adjacent marking material extending 1 foot in any direction. After surface preparation work is complete, finish the repair by reapplying new marking material over the cleaned pavement surface according to the requirements of these specifications.

2. Non-conformance with the contract documents may include, but is not limited to:
   - **a.** Pavement markings that:
     - have drag marks, gashes, gouges, foreign covering, discolored areas or areas that have failed to solidify.
     - have improper adhesion, length, color, thickness, or bead embedment.
     - have areas that present a ragged appearance, areas that do not present sharply defined edges, or areas with abrupt unintended changes in alignment.
   - **b.** Pavement marking grooves that are not of the correct width, length, depth, cross slope, or alignment.
   - **c.** Markings that are not substantially placed within each intended pavement marking groove, when grooving is required and the grooves are placed in conformance with the contract documents.
   - **d.** Lines or grooves that deviate laterally from the intended alignment by more than 2 inches in 200 feet may be rejected.
   - **e.** Lines or grooves that do not meet the required widths. No more than 300 feet of deficient width line or groove may be allowed to remain in each 1 mile segment.
   - **f.** Lines that do not meet minimum retroreflectivity requirements as listed in Table 23090.02-1. Markings shall be evaluated in 1 mile increments by the requirements listed in Materials I.M. 386. For any 1 mile section in which the average of all readings in a single line does not meet minimum retroreflectivity requirements, the markings in the entire 1 mile section of that line shall be fully removed and replaced.

23090.04 METHOD OF MEASUREMENT.

A. Measurement for pavement markings, pavement markings removed, and grooves cut, satisfactorily placed, removed, or approved, will be as follows:

1. **Painted Pavement Markings, Multi-Component Liquid.**
   Stations placed.

2. **Pavement Markings Removed.**
   Stations Removed.

3. **Grooves Cut for Pavement Markings.**
   Stations. This quantity will be equivalent to the number of stations measured for the pavement markings. Additional width and transition length will be incidental.

B. The Engineer will measure the number of stations, based on a single 6 inch width of line. The length of markings will be determined using beginning and ending points, and adjusting for breaks at ramps, station equations, or other locations shown in the contract documents. The measurement for dashed and dotted lines will be adjusted to exclude skips. Measurement of lines wider than 6 inches will be adjusted by the quantity factor to a 6 inch line.

23090.05 BASIS OF PAYMENT.
Painted Pavement Markings, Multi-Component Liquid; Pavement Markings Removed; and Grooves Cut for Pavement Markings will be paid for per Article 2527.05 of the Standard Specifications.