

**ITEM 740 PAVEMENT MARKING MATERIAL**

**740.01 General.** Use permanent pavement marking materials meeting the requirements of this specification and passing the service test required by ODOT Supplement 1047 included on the QPL maintained by the Laboratory. The Laboratory may retest pavement marking materials pre-qualified by a service test to determine formulation compliance to pre-qualified material and compliance with physical properties specified in this section. Submit certified test data and samples to the Laboratory. The City will consider failure of testing or certified test data to show formulation conforming to pre-qualified material or compliance with specified physical properties as cause for removal of the material from the QPL.

Deliver the marking material in containers clearly marked to indicate the number of gallons (liters), weight or size of material, material density (weight per unit volume), material color, batch number or other similar manufacturer's identification, date of production, and the company name and address.

**740.02 Traffic Paint.** Provide white and yellow ready-mixed traffic paint suitable for marking various types of pavement. Prequalify materials in accordance with ODOT Supplement 1047. Use materials certified in accordance with City Supplement 1089. Provide paint capable of binding with glass beads in accordance with 740.09 Type A, on pavement exposed to traffic. Furnish paint that will not deteriorate in storage, within one year after date of receipt, to the extent that it cannot be readily broken up with a paddle to a smooth uniform paint capable of easy application by spray.

Provide paint capable of not bleeding or discoloring when sprayed on asphalt concrete surfaces.

Type 1 paint - the fast dry, water-based, 100 percent acrylic type.

Type 1A paint - fast dry, water-based, 100 percent acrylic type, used for cold weather applications.

Use Type 1A paint conforming to the following requirements:

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<b>Property</b>	<b>Test Method</b>	<b>Requirements (Applies to both White and Yellow, unless noted)</b>
Total Solids	ASTM D2369	70% minimum by weight
		58% minimum by volume
Titanium Dioxide, rutile type II	ASTM D1394	1 lb/gal (120 g/l) minimum, White 0.2 lb/gal (24 g/l) minimum, Yellow
Pigment % by Weight	ASTM D3723	+/- 2% of qualifying sample
Weight per Gallon	ASTM D1475	+/- 0.3 lb/gal (36 g/L) of qualifying sample
Color	ODOT Supplement 1047	Appendix A
Viscosity (krebs units)	ASTM D562	70 minimum and 95 maximum @ 77°F (25°C)
Lab Drying Time	ASTM D711	10 minutes max. @ 77°F (25°C), 50% RH 12 minutes max. @ 50°F (10°C), 50% RH 14 minutes max. @ 35°F (1.7°C), 50% RH

Prequalify materials in accordance with ODOT Supplement 1047. Use materials certified in accordance with City Supplement 1089.

**740.03 Polyester Pavement Marking.** Provide a two part polyester polyester pavement marking material capable of application at ambient temperatures down to 50 °F (10 °C). Provide material capable of retaining reflective glass beads after application, in accordance with 740.09 Type B.

Provide the catalytic component of the system from the commercially available type recommended by the manufacturer of the polyester.

Use the ratio of the catalyst to resin as specified by the manufacturer.

Provide the polyester conforming to the following requirements:

		Minimum	Maximum
1.	Consistency, Krebs units ASTM D 562, Procedure A:	70	90
2.	Field Dry Time (No Track), minutes:	--	45
Provide pavement marking material capable of a "no tracking condition" in 45 minutes. The Engineer will determine the "no tracking condition" by applying the markings and beads in accordance with the specification requirements to dry pavements at a low temperature of 50 (10 C) and high temperature of 120 F (49 C). Run tests at the manufacturer's highest and lowest recommended application humidity. Apply the marking materials at the manufacturer's recommended application temperature. The Engineer will determine the "no tracking" time by passing over the line with a passenger car at a speed of 25 to 35 mph (44 to 55 kmph) in a simulated passing maneuver. The Engineer will consider a line showing no visual deposition of the material to the pavement surface when viewed at a distance of 50 ft (15 m) as showing "no tracking" and conforming to this requirement for time to "no track".			
3.	Prime Pigment Content, percent by weight of paint:		
	White ASTM D 1394	13.9	--
	Yellow ASTM D 126 or City approved lab method	13.8	--
4.	Pigment Content, percent by weight of paint ASTM D 2698:		
	White	--	40
	Yellow	--	41
5.	Nonvolatile Vehicle Solids Content, percent by weight of paint FED STD 141C, Method 4053.1:		
	White	31	--
	Yellow	29	--
6.	Fineness of Dispersion, ASTM D 1210 micrometers,	50	--
7.	Bleeding Ratio, Fed. Std. TT-P-115F, Section 4.3.2:		
	White	0.93	--
	yellow	0.92	--
8.	Color:		
	a. White, Daylight Directional Reflectance, ASTM E 1347:	85	--
	b. Yellow	50	--
	1. Refer to Highway Yellow Color Tolerance Chart PR Color No. 1, June, 1965 U.S. Dept. of Transportation, FHWA: Yellow, Color Difference 595-33538, ASTM D 2244		
	i. Measure E, L, a, b as Cielab, Source "C"		
	L	+0.75	+1.0
	a	+0.9	+1.7
	b	+4.4	+5.1
9.	Dry Opacity, ASTM D 2805 at 0.005 wet: Fed Std 141 No 4121 Process B, Method A, white and yellow	0.97	--
10.	Condition in container Fed Std 141 No 3011.2, hand stirring by spatula, minutes		5

Prequalify materials in accordance with ODOT Supplement 1047. Use materials certified in accordance with City Supplement 1089.

**740.04 Thermoplastic Pavement Marking.** Provide thermoplastic pavement marking material formulated expressly for use as retroreflective pavement markings on asphalt concrete or Portland cement concrete pavement. Provide material that includes a mixture of Alkyd resins-19% minimum by weight with at least one resin that remains solid at room temperature, and contains premixed glass beads 740.09 Type C, 30%

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minimum by weight, with a 1.50 minimum index of refraction. Ensure that the ingredients are well mixed so that all parts are evenly dispersed throughout. Do not allow any foreign objects, skins, dirt, or such ingredients in the mix that would cause staining, discoloration, or bleeding. Provide suitable materials for application in molten form by the extrusion method. Provide material capable of retaining reflective glass beads after application, in accordance with 740.09 Type C.

**A. Specific Gravity.** Provide thermoplastic compound having a specific gravity of 1.6 to 2.3 at 77 °F (25 °C) ASTM D 792.

**B. Flowability.** Meet percent residue requirements in accordance with the following requirements:

1. AASHTO M 249, Section 4.3.6 and
2. AASHTO M 249, Section 4.3.8

**C. Drying Time.** AASHTO M249, Section 4.3.2.

**D. Field Placement Stability.** Provide material that, after proper application and drying time, does not tack and does not have an appreciable deformation or discoloration when subjected to typical vehicular traffic in air or road temperatures between -30 and 140 °F (-34 and 60 °C). Provide material capable of forming markings of a constant cross-section with a uniform density and character. Provide markings that maintain their original shape and pavement position.

**E. Ring and ball Softening Point.** Provide a material with a softening point of not less than 190 °F (88 °C) when tested in accordance with ASTM E 28.

**F. Impact Resistance.** AASHTO M 249, Section 4.3.4

**G. Pigment Content** G. Pigment Content. Provide yellow material containing a minimum of 5 percent by weight of primary yellow (lead chromate) pigment (or a lead free pigment) (measured as per ASTM D 126 or City approved lab method). Provide white material containing a minimum of 10 percent Titanium Dioxide-Rutile Type -2 by weight of white pigment.

**H. Color.**

	<b>Minimum</b>	<b>Maximum</b>
a. White, Daylight Directional Reflectance, ASTM E 1347	75	--
b. Yellow	50	--
1. Refer to Highway Yellow Color Tolerance Chart PR Color No. 1, June, 1965 U.S. Dept. of Transportation, FHWA: Yellow, Color Difference 595-13538, ASTM D 2244		
Measure E, L, a, b as Cielab, Source "C"		
L	+0.75	+1.0
a	+0.9	+1.7
b	+4.4	+5.1

**I. Yellowness Index**, AASHTO M 249, Section 4.3.7

Prequalify materials in accordance with ODOT Supplement 1047. Use materials certified in accordance with City Supplement 1089.

**740.05 Preformed Pavement Marking.** Provide the preformed material suitable for retroreflective pavement markings on asphalt concrete or portland cement concrete pavement. Provide material free of cracks and having straight, true, and unbroken edges. Use flexible, formable material suitable for application with an adhesive without heating. Provide material containing glass beads uniformly distributed throughout with a 1.50 minimum index of refraction. Place a uniform surface layer of firmly bonded glass beads on the material to provide the initial minimum specific luminance values specified for the various types of material.

Provide material that resists deterioration by contact with highway deicing chemicals or because of the oil content of asphalt concrete pavement, or from oil droppings and other effects of traffic.

**A. Type A1 Material.** Provide Type A1 material conforming to ASTM D 4505, Level 1, Classes 2 or 3, and having a thickness of not less than 0.090 inch (2.28 mm), including any pre-coated adhesive layer.

**B. Type A2 Material.** Provide Type A2 material conforming to ASTM D 4505, Level 1, Classes 2 or 3, and having a thickness of not less than 0.060 inch (1.52 mm), including any pre-coated adhesive layer.

**C. Type A3 Material.** Provide Type A3 material conforming to ASTM D 4505, Level 1, Classes 2 or 3, skid resistance level A, and having a minimum thickness at the thinnest portion of the cross-section of not less than 0.020 inch (0.50 mm), including any pre-coated adhesive layer.

Prequalify materials in accordance with ODOT Supplement 1047. Use materials certified in accordance with City Supplement 1089.

**740.06 Work Zone Pavement Marking.** Provide work zone pavement marking material conforming to ASTM D 4592, Type I (removable) or Type II (non-removable) with the following modifications:

A. Type I (removable): 0.030-inch (0.76 mm) minimum thickness.

B. Type II (non-removable): 0.015-inch (0.38 mm) minimum thickness.

Provide materials conforming to the requirements in this section. Receive approval from the Engineer before use.

**740.07 Epoxy Pavement Marking Material.** Provide material with a 100% solids two-part epoxy system capable of application at ambient temperature down to 50 °F (10 °C). Provide a slow cure material capable of retaining reflective glass beads 740.09 type D, after application.

Provide epoxy conforming to the following requirements:

**A. Formulation.** Provide epoxy formulated as a Long Life Pavement Marking System, capable of providing a minimum of 4 years of performance, free of any peroxides and any Tri-methylpropane Tri-acrylate) TMPTA and other multi-functional

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monomers. Design the epoxy to provide simple volumetric mixing ratio of its components (such as 2:1).

**B. Epoxide Number.** Provide epoxy with an epoxide number of the epoxy resin conforming to the manufacturer's target value  $\pm 0.05$  as determined by ASTM D 1652 for both white and yellow Part A on a pigment free basis.

**C. Amine Number.** Provide curing agent with the amine number of the curing agent (Part B) conforming to the manufacturer's target value  $\pm 50$  as determined by ASTM D 2074 on a pigment free basis.

**D. Laboratory Drying Time.** Provide pavement marking material, when mixed in the proper ratio and applied at the properly prescribed wet film thickness at  $75 \pm 2$  °F ( $24 \pm 0.5$  °C) and with the proper saturation of glass beads, exhibiting a no tracking time of no greater than 40 to 45 minutes when tested in accordance with ASTM D 711.

**E. Field Time to No-Track.** Use pavement marking material providing a "no tracking condition" within 15 to 45 minutes. The Engineer will determine the "no tracking condition" by applying the markings and beads at the specification requirements to dry pavements at a low temperature of 45°F (7°C) and high temperature of 120°F (49°C). Run tests at the manufacturer's highest and lowest recommended application humidity. Apply the marking materials at the manufacturer's recommended application temperature. The Engineer will determine the "no tracking" time by passing over the line with a passenger car at a speed of 25 to 35 mph (44 to 55 kmph) in a simulated passing maneuver. The Engineer will consider a line showing no visual deposition of the material to the pavement surface when viewed at a distance of 50 ft (15 m) as showing "no tracking" and conforming to this requirement for time to "no track". Protect the line from tracking during the setting period by coning off or as shown on the plans.

**F. Field Curing.** Provide epoxy pavement marking material capable of fully curing at a constant surface temperature of 45 °F (7 °C) or above.

**G. Hardness.** Provide epoxy pavement marking materials, when tested in accordance with ASTM D 2240, having a Shore D Hardness between 70 and 90. Allow samples to cure at room temperature  $75 \pm 2$  °F ( $24 \pm 0.5$  °C) for a minimum of 24 hours and a maximum of 72 hours before performing the indicated test.

**H. Certified test data.** Provide a material manufacturer's certified test data showing material compliance with the provisions of this section. A certification of compliance does not waive the requirements for a state inspection, sampling, or testing.

**I. Infrared Spectra.** Supply a copy of the infrared spectra of each component on each lot number.

**J. Material Performance Qualifications.** Verify the manufacturer's expertise and performance history including: completed and passed service tests in accordance with ODOT Supplement 1047; verifiable installations; ample production capacity; proper facility; compliance with EPA regulations; verifiable quality control program; and passed a minimum of 4 years of performance (durability and retroreflectivity) on concrete or asphalt surface in the State.

**K. Condition in Container.** Perform tests in accordance with Fed Std 141 No. 3011.2, Hand Stirring by Spatula, 5 minutes maximum.

Prequalify materials in accordance with ODOT Supplement 1047. Use materials certified in accordance with City Supplement 1089.

**740.08 Heat-Fused Preformed Plastic Pavement Marking Material.** Provide heat-fused preformed plastic pavement marking materials pre-qualified in accordance with ODOT Supplement 1047, and conforming to the following Type A, Pre-heated Pavement tape and Type B, Post-heated tape:

Type A90 and B90 - 90 mil thickness (2.29 mm)

Type A125 - 125 mil thickness (3.18 mm)

Type B125 - 125 mil thickness (3.18 mm)

Glass beads..... 740.09

The City will field service test the pavement marking material and glass beads as a system. The City will consider those systems performing satisfactorily for addition to the QPL. The City reserves the right to perform random performance check sampling of materials.

Use materials certified in accordance with City Supplement 1089.

**740.09 Glass Beads.**

**A. Type A.** Provide Type A glass beads for traffic paint conforming to ODOT Supplement 1008 and to AASHTO M 247, Type 1 without flotation properties, but dual coated (for moisture resistance and adhesion), with the following exception: 4.6 Flotation Test.

Package the glass beads for traffic paint in bags designated “740.02”. Use materials certified in accordance with City Supplement 1089.

**B. Type B.** Provide Type B glass beads for polyester marking material conforming to AASHTO M 247, Type 1 with  $50 \pm 5$  percent flotation coating and with a  $50 \pm 5$  percent moisture resistant coating retained on each sieve, with the following exception: 4.6 Flotation Test. Ensure that the minimum percent floating equals 90 of flotation coated beads or 40.5 percent of total mixture. Package the glass beads for polyester marking material in bags designated “POLY”.

Use materials certified in accordance with City Supplement 1089.

**C. Type C.** Provide Type C glass beads for thermoplastic material meeting the following requirements:

Sieve Size	Percent Retained
No. 16 (1.18 mm)	3 max
No. 20 (850 mm)	5 to 20
No. 40 (425 mm)	65 to 95
No. 50 (300 mm)	0 to 5
Refractive Index	1.50 to 1.60
Roundness	80 min
Coating	Moisture Resistant (For Drop-on Beads only)

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Clearly mark the glass bead packaging “THERMO”

Use materials certified in accordance with City Supplement 1089.

**D. Type D.** Glass beads for Epoxy Pavement Marking.

Clearly indicate EPOXY - SIZE I or EPOXY SIZE II on the glass bead packaging.

Provide glass beads having the following gradation when tested in accordance with City Supplement 1089.

SIZE I		SIZE II	
Sieve Size	Percent Retained	Sieve Size	Percent Retained
No. 10 (2.00 mm)	0	No. 20 (850 µm)	0 to 5
No. 12 (1.70 mm)	0 to 5	No. 30 (600 µm)	5 to 20
No. 14 (1.40 mm)	5 to 20	No. 50 (300 µm)	30 to 75
No. 16 (1.18 mm)	40 to 80	No. 80 (180 µm)	9 to 32
No. 18 (1.00 mm)	10 to 40	No. 100 (150 µm)	0 to 5
No. 20 (850 µm)	0 to 5	pan	0 to 2
Pan	0 to 2		

Reflective Media: Provide smooth, clear glass beads free from any air inclusions, and scratches affecting their functions as a retro-reflective media, and having the characteristics listed below.

Roundness (Percent by Weight): Provide beads with not more than 20 percent of the glass beads irregular or fused spheroids and with at least 80 percent of the beads true beads.

Index of Refraction: Provide beads with a refractive index of a minimum of 1.50 as determined by the liquid immersion method at 77 °F (25 °C). Provide beads with a silica content of glass beads not less than 60 percent.

Coating: Provide Size I glass beads coated with a silane-type adherence coating to enhance its embedment in, and adherence to the applied binder film. Provide coated beads emitting a yellow-green fluorescence when tested by the Dansyl Chloride test procedure. Provide Size II glass beads treated with a moisture-proof coating. Provide both types of glass beads showing no tendency to absorb moisture in storage and remaining free of clusters and lumps. Ensure that the beads flow freely from the dispensing equipment at any time when surface and atmosphere conditions are satisfactory for marking operations.

Determine the moisture-resistance of the glass beads on the basis of the following test:

Place 2.2 pounds (1 kg) of beads in a washed cotton bag, having a thread count of 50 per square inch (8/cm<sup>2</sup>) (warp and woof) and immerse the bag in a container of water for 30 seconds. Remove the bag and force the excess water from the sample by squeezing the bag. Suspend and allow the beads to drain for two hours at room temperature 70 to 72 °F (21 to 22 °C). After draining, mix the sample in the bag by shaking thoroughly. Transfer a sample slowly to a clean, dry glass funnel having a stem 4 inches (100 mm) in length, with a 3/8-inch (10 mm) inside diameter stem entrance opening, and a

minimum exit opening of 1/4 inches (6 mm). Ensure that the entire sample flows freely through the funnel without stoppage. When first introduced to the funnel, if the beads clog, tap the funnel to initiate flow.

Use materials certified in accordance with City Supplement 1089.

**740.10 Spray Thermoplastic Pavement Marking.** Provide spray thermoplastic pavement marking material specially formulated for use as retroreflective pavement markings on asphalt concrete or Portland cement concrete pavement. Provide material that includes a mixture of resins with at least one resin that remains solid at room temperature, and contains uncoated premixed glass beads, in accordance with 740.09 Type C. Mix the ingredients well to evenly disperse all parts throughout the mix. Remove foreign objects, skins, dirt, or such ingredients that would cause staining, discoloration, or bleeding. Provide suitable materials for spray application in molten form. Provide material capable of retaining drop on reflective glass beads, in accordance with 740.09 Type C, after application.

**A. Composition.**

	<u>White</u>	<u>Yellow</u>
Binder	25% Min.	25% Min.
TiO <sub>2</sub> Pigment (Type II Rutile)	10% Min.	
Lead-Free Pigment (Yellow 83)	N/A	*
Inter mixed Glass Beads	30% Min. (by weight)	30% Min. (by weight)
Filler	35% Max.	42% Max.

\* amount of lead-free pigment is at the discretion of the manufacturer, as long as all other compositional requirements are met

**B. Binder.** Provide alkyd-based binder consisting of a mixture of synthetic resins with at least one resin that remains solid at room temperature, and high boiling plasticizers. Provide at least one-third of the binder composition as maleic modified glycerol ester of rosin, consisting of no less than 8 percent by weight of the entire material formulation.

**C. Pigment.** Provide titanium dioxide pigment of a Rutile type with a minimum purity of 92%.

Use lead-free Pigment Yellow 83 produced to meet the requirements of FED 595 Color No. 13538.

**D. Filler.** Ensure filler to be incorporated with the resins is a white calcium carbonate, silica, or any approved substitute. Ensure that any filler, which is insoluble in 6N hydrochloric acid, passes a 150 µm (No. 100) sieve.

**E. Color.** Provide pure white spray thermoplastic, free from any tint with a minimum daylight reflectance (Y) of 75. Do not exceed the yellowness index of 0.15 when tested in accordance with ASTM D4960 and E313.

Visually match yellow spray thermoplastic with FED 595 Color No. 13538. Provide a daytime reflectance (Y) greater than 45.

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Ensure white and yellow colors fall within the chromaticity coordinates of the color box in Appendix A of ODOT Supplement 1047.

**G. Specific Gravity.** Provide spray thermoplastic material having a specific gravity of 1.85-2.15.

**H. Softening Point.** After heating the marking compound for 4 hours  $\pm$  5 min. at 375°F  $\pm$  3°F (190°C  $\pm$  2°C) and testing in accordance with ASTM E28, verify a minimum softening point of 180°F (82°C) as measured by the ring and ball method.

**I. Bond Strength.** After heating the marking compound for 4 hours  $\pm$  5 min. at 375°F  $\pm$  3°F (190°C  $\pm$  2°C), verify the tensile bond strength exceeds 180 psi (1.24 MPa) when tested in accordance with ASTM D4796.

**J. Impact Resistance.** After heating the marking compound for 4 hours  $\pm$  5 min. at 375°F  $\pm$  3°F (190°C  $\pm$  2°C), verify a minimum impact resistance of 50 inch pounds (0.576 kilogram meters) when tested in accordance with ASTM D2794. Verify no cracks or bond loss occur when making a 0.0625 inch (1.587 mm) thick film drawdown at 375°F  $\pm$  3°F (190°C  $\pm$  2°C) on an unprimed sandblasted Portland cement concrete block. Test sample with a 5/8-inch (15.875-mm) male indenter and no female Die, at room temperature.

**K. Indentation Resistance.** When tested in accordance with ASTM D 2240 using a Shore Durometer, Type A2, with a 2.2 pound (1 kg) load, ensure hardness between 5 and 30 after 15 seconds of contact with the sample. Ensure a durometer and sample at 113°F  $\pm$  3°F (45°C  $\pm$  2°C).

Prequalify materials in accordance with ODOT Supplement 1047. Use materials that follow the requirements of City Supplement 1089.