971 COATINGS AND TRAFFIC MARKING MATERIALS.
(REV 7-11-05) (FA 8-9-05) (1-06)

SECTION 971 (Pages 881-915) are deleted and the following substituted:

SECTION 971
TRAFFIC MARKING MATERIALS

971-1 General Requirements.

971-1.1 Packaging and Labeling: All traffic marking materials shall be shipped in strong containers plainly marked with the weight in pounds per gallon [kilograms per liter], the volume of traffic marking materials content in gallons [liters], the color, user information, date of manufacture, LOT, batch and DOT code number. Each batch manufactured shall have a unique number. A true statement of the percentage composition of the pigment, the proportion of pigment to vehicle, and the name and address of the manufacturer, also shall be shown. The label shall warn the user of any special handling or precautions of the material, as recommended by the manufacturer. Any package not so marked will not be accepted for use under these specifications.

Preformed thermoplastic materials and permanent tape products shall be marked with content, color, date of manufacture and lot number.

971-1.2 Storage: Any traffic marking materials which, although inspected and approved at the point of manufacture, hardens or livers in the containers so that it cannot be readily broken up with a paddle to a smooth, uniform painting consistency, will be rejected. All materials shall have a container storage life of one year from date of manufacture. Any traffic marking materials not acceptable for proper application will be rejected, even though it conforms to these Specifications in all other respects.

971-1.3 Mixing: All paints shall be delivered to the project completely mixed, and ready to be used without additional oil or thinner. Gasoline shall not be used for thinner under any circumstances.

971-1.4 Qualified Products List: All traffic marking materials shall be one of the products listed on the Qualified Products List. Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6 accompanied by a copy of the infrared identification curve (2.5 to 15 µm) for the vehicle component.

Products may only be used for applications recommended by the manufacturer.

A notation of the number of coats and the thickness of each coat at which the product passes testing may be placed on the QPL. When listed, this will be the minimum criteria for application of the traffic marking material.

971-1.5 Certification: The Contractor shall provide the Engineer a certification conforming to the requirements of Section 6 from the manufacturer of the traffic marking materials confirming that the requirements of this Section are met. Each certification shall cover only one batch for traffic marking material.

971-1.6 Samples: Field samples will be obtained in accordance with the Department's Sampling, Testing and Reporting Guide Schedule.

971-1.7 Color: Materials for pavement markings shall meet the performance requirements specified in ASTM D 6628 with the exception of the following requirements.

The initial daytime chromaticity for yellow materials shall fall within the box created by the following coordinates:

Initial Daytime Chromaticity Coordinates (Corner Points)

	1	2	3	4
X	0.530	0.510	0.455	0.472
Y	0.456	0.485	0.444	0.400

The in-service daytime chromaticity for yellow materials shall fall within the box created by the following coordinates:

In-Service Daytime Chromaticity Coordinates (Corner Points)

	1	2	3	4
X	0.530	0.510	0.435	0.449
Y	0.456	0.485	0.429	0.377

971-1.8 Additional Requirements: Traffic stripe materials shall be characterized as non-hazardous as defined by Resource Conservation and Recovery Act (RCRA) Subarticle C rules, Table 1 of 40 CFR 261.24 “Toxicity Characteristic”. Traffic stripe materials shall contain no more than 3.0 ppm lead by weight in a cured state when tested by EPA methods 3050 and 6010.

The material shall not exude fumes which are hazardous, toxic or detrimental to persons or property.

971-2 Glass Spheres.

971-2.1 General Requirements: Glass spheres shall be of a composition designed to be highly resistant to traffic wear and to the effects of weathering for the production of a reflective surface, creating night visibility of the pavement markings without altering day visibility of the marking. The general requirements of 971-1 apply to glass spheres.

The glass spheres shall conform to the requirements of AASHTO M 247 and FP 96.

971-2.2 Specific Properties: The large (Type 3 or larger) glass spheres used for drop on beads shall have an adhesion coating. Type 1 glass spheres used for drop on beads shall have a dual coating. Beads used in the intermix of materials are not required to be coated.

The following physical requirements apply:

Property	Test Method	Specification
Gradation	ASTM D 1214	AASHTO M 247 & FP
Roundness	ASTM D 1155	Min: 70 % true spheres by weight per sieve size
Refractive Index	Becke Line Method (25+/-5C)	1.5 minimum

Sieve Size	Percent by Mass Passing Designated Sieve (ASTM D 1214)			
	Grading Designation			
	Type 1 (AASHTO)	Type 3 (FP 96)	Type 4 (FP 96)	Type 5 (FP 96)
No. 8				100

No. 10			100	95 – 100
No. 12		100	95 – 100	80 – 95
No. 14		95 – 100	80 – 95	10 – 40
No. 16		80 – 95	10 – 40	0 – 5
No. 18		10 – 40	0 – 5	0 – 2
No. 20	100	0 – 5	0 – 2	
No. 25		0 – 2		
No. 30	75 – 95			
No. 40				
No. 50	15 – 35			
No. 80				
N0. 100	0 – 5			

Provide the Engineer Certified test reports from the manufacturer confirming that all glass spheres conform to the requirements of this Section.

971-2.3 Sampling:

971-2.3.1 Sampling: A random 50 lb [23 kg] sample of glass spheres shall be obtained for each 50,000 lb [22,680 kg] shipped. Upon arrival, the quantity of material will be reduced in a sample splitter to a size of approximately 1 quart [1 liter] by the Engineer, or one 50 lb [23 kg] unopened bag.

971-2.3.2 Containers: The spheres shall be furnished in new 50 lb [23 kg] moisture-proof bags. All containers shall meet ICC requirements for strength and type and be marked in accordance with AASHTO 247 Part 5.

971-3 Fast Dry Traffic Paint - Water Borne.

971-3.1 General: Fast dry traffic paints intended for use under this Specification shall include water reducible products that are single packaged and ready mixed. Upon curing, these materials shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic. The material shall have the capability of being cleaned and flushed from the striping machines using regular tap water and any required rust inhibitors. The manufacturer shall have the option of formulating the material according to his own specifications. However, the requirements delineated in this Specification and Section 710 shall apply regardless of the type of formulation used. The material shall be free from all skins, dirt and foreign objects.

971-3.2 Composition:

Component	Test Method	Criteria
Total Solids, by weight	ASTM D 2369	minimum 75%
Pigments, by weight	ASTM D 3723	minimum 57%
Vehicle Solids % on Vehicle*		minimum 40%
TiO_2, Type II Rutile (white paint only)	ASTM D 476	minimum 1.5 lb/gal [0.18 kg/L]
Volatile Organic Content, (VOC)	ASTM D 3960	maximum 150 g/L
* % total solids - % pigment / 100 - % pigment		

971-3.3 Physical Requirements: The material shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Density	ASTM D 1475	13.5 ± 1.4 lb/gal [1.62 ± 0.17 kg/L]	-
Consistency at 77ºF [25ºC]	ASTM D 562	80 KU	100 KU
Fineness of Grind	ASTM D 1210	2(HS) [75 µm]	3(HS) [63 µm]
Dry Opacity at 5 mils [127 µm] WFT	Fed Std 141a Method 4121	0.96	-
Bleed Ratio	Fed Spec TT-P-85D	0.95	-
Flexibility	Fed Spec TT-P-115D	Pass	-
Abrasion Resistance	961-10.6.3	Pass	-

971-3.3.1 Set To Bear Traffic Time: When applied at the temperatures and thickness specified by Section 710, the material shall set to bear traffic in not more than two minutes.

971-3.3.2 Abrasion Resistance: Test four samples per LOT using a Taber Abrader. The paint shall be applied to specimen plates using a drawdown blade having a clearance of 26 mils [660 µm]. Air dry each sample for 30 minutes and bake at 220ºF [105ºC] for 18 hours. Clean with a soft brush and weigh each sample. Abrade samples for 1,000 cycles with 500 g weights and CS-10 wheels. Clean the samples with a soft brush and weigh again. The average weight loss for the four plates shall not exceed 50 mg per plate.

971-3.3.3 Retroreflectivity: The white and yellow pavement markings shall attain an initial retroreflectance of not less than 300 mcd/lx·m^2 and 250 mcd/lx·m^2. The retroreflectance of the white and yellow pavement markings at the end of the six month service life shall not be less than 150 mcd/lx·m^2.

971-3.4 Packaging and Labeling: The traffic paint shall be placed in 55 gal [210 L] open-end steel drums with a re-usable multi-seal sponge gasket. No more than 50 gal [190 L] of material shall be placed in any drum to allow for expansion during transport and storage.

971-4 Fast Dry Solvent Traffic Paint.

971-4.1 General: Fast dry traffic paints intended for use under this Specification shall include products that are single packaged and ready mixed. Upon curing, these materials shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic. The manufacturer shall have the option of formulating the material according to his own specifications. However, the requirements delineated in this Specification and Section 710 shall apply regardless of the type of formulation used. The material shall be free from all skins, dirt and foreign objects.

971-4.2 Composition:

Component	Test Method	Criteria
Total Solids, by weight	ASTM D 2369	75% minimum
Pigments, by weight	ASTM D 3723	57% minimum
Vehicle Solids, % on Vehicle*		40% minimum
TiO_2, Type II Rutile (white paint only)	ASTM D 476	1.5 lb/gal [0.18 kg/L] minimum
Volatile Organic Content, (VOC)	ASTM D 3960	150 g/L maximum

971-4.3 Physical Requirements: The material shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Density	ASTM D 1475	13.5 ± 0.37 lb/gal [1.62 ± 0.17 kg/L]	N/A
Consistency at 170ºF [77ºC]	ASTM D 562	80 KU	100 KU
Fineness of Grind	ASTM D 1210	2 (HS) [75 µm]	3(HS) [65 µm]
Dry Opacity at 5 mils [127 µm] WFT	Fed Std 141a Method 4121	0.96	-
Bleed Ratio	Fed Spec TT-P-85D	0.95	-
Flexibility	Fed Spec TT-P-115D	Pass	-
Abrasion Resistance	961-10.6.3	Pass	-

971-4.3.1 Set To Bear Traffic Time: When applied at the temperatures and thickness specified by Section 710, the material shall set to bear traffic in not more than two minutes.

971-4.3.2 Abrasion Resistance: Test four samples per LOT using a Taber Abrader. The paint shall be applied to specimen plates using a drawdown blade having a clearance of 26 mils [660 µm]. Air dry each sample for 30 minutes and bake at 220ºF [105ºC] for 18 hours. Clean with a soft brush and weigh each sample. Abrade samples for 1,000 cycles with 1.1 lb [500 g] weights and CS-10 wheels. Clean the samples with a soft brush and weigh again. The average weight loss for the four plates shall not exceed 0.178 oz [50 mg] per plate.

971-4.3.3 Retroreflectivity: The white and yellow pavement markings shall attain an initial retroreflectance of not less than 300 mcd/lx·m^2 and 250 mcd/lx·m^2, respectively. The retroreflectance of the white and yellow pavement markings at the end of the six month service life shall not be less than 150 mcd/lx·m^2.

971-4.4 Application Properties: Application properties shall meet the requirements of Section 710.

971-4.5 Packaging and Labeling: The traffic paint shall be placed in 55 gal [210 liter] open-end steel drums with a re-usable multi-seal sponge gasket. No more than 50 gal [190 liters] of material shall be placed in any drum to allow for expansion during transport and storage.

971-5 Thermoplastic Materials for Traffic Stripes.

971-5.1 General: Upon cooling to normal pavement temperature, these materials shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic. The manufacturer shall utilize alkyd based materials only and shall have the option of formulating the material according to his own specifications. However, the requirements delineated in this Specification and Section 711 shall apply regardless of the type of formulation used. The pigment, glass spheres, and filler shall be well dispersed in the resin. The material shall be free from all skins, dirt and foreign objects.

971-5.2 Composition:

Component	Test Method	White	Yellow
Binder		20.0% minimum	20.0% minimum
TiO_2, Type II Ructile	ASTM D 476	10.0% minimum	-
Glass Spheres	AASHTO T 250	40.0% minimum	40.0% minimum
Yellow Pigment		-	% minimum per manufacturer
Calcium Carbonate and Inert Filler (-200 mesh [-75 µm] sieve)		30.0% maximum	37.5% maximum
Percentages are by weight.			

The alkyd/maleic binder must consist of a mixture of synthetic resins (at least one synthetic resin must be solid at room temperature) and high boiling point plasticizers. At least one-half of the binder composition must be 100% maleic-modified glycerol of rosin and be no less than 15% by weight of the entire material formulation.

971-5.3 Glass Spheres: The glass spheres in the intermix shall consist of 50% Type 1 and 50% Type 3. Glass spheres shall meet the requirements of 971-2.

971-5.4 Sharp Silica Sand: Sharp silica sand used for bike lane symbols and pedestrian crosswalk lines shall meet the following gradation requirements:

Sieve Size	% Passing
20 [850 µm]	100
50 [300 µm]	0 to 10

971-5.5 Physical Requirements: Laboratory samples shall be prepared in accordance with ASTM D 4960 and shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Water Absorption	ASTM D 570	-	0.5%
Softening Point	ASTM D 36	195ºF [90ºC]	-
Low Temperature Stress Resistance	AASHTO T 250	Pass	-
Specific Gravity	Water displacement	1.9	2.3
Indentation Resistance	ASTM D 2240* Shore Durometer, A2	40	75
Impact Resistance	ASTM D 256, Method A	1.0 N·m	-
Flash Point	ASTM D 92	475ºF [245ºC]	-
*The durometer and panel shall be at 110ºF [45ºC] with a 4.4 lb [2.0 kg] load applied. Instrument measurement shall be taken after 15 seconds.			

971-5.5.1 Set To Bear Traffic Time: When applied at the temperatures and thickness specified by Section 711, the thermoplastic shall set to bear traffic in not more than two minutes.

971-5.5.2 Retroreflectivity: The white and yellow pavement markings shall attain an initial retroreflectance of not less than 450 mcd/lx·m^2 and not less than 350 mcd/lx·m^2,

respectively. The retroreflectance of the white and yellow pavement markings at the end of the three year service life shall not be less than 150 mcd/lx·m^2.

971-5.5.3 Durability: Durability is the measured percent of thermoplastic material completely removed from the pavement. The thermoplastic material line loss must not exceed 5.0% at the end of the service life.

971-5.6 Application Properties: Application properties shall meet the requirements of Section 711.

971-5.7 Packing and Labeling: The thermoplastic material shall be packaged in suitable biodegradable or thermo-degradable containers which will not adhere to the product during shipment and storage. The container of thermoplastic material shall weigh approximately 50 lb [23 kg]. The label shall warn the user that the material shall be heated in the range as recommended by the manufacturer.

971-6 Thermoplastic Material - Hot Spray.

971-6.1 General: This work shall consist of furnishing and applying thermoplastic material when the project requires refurbishing existing thermoplastic stripes. The manufacturer shall utilize alkyd based materials only and shall have the option of formulating the material according to his own specifications. However, the requirements delineated in this Specification and Section 711 shall apply regardless of the type of formulation used.

971-6.2 Composition:

Component	White	Yellow
Binder	25.0% minimum	25.0% minimum
TiO_2 (ASTM D 476 Type II Ructile)	10.0% minimum	-
Glass Spheres	35.0% minimum	35.0% minimum
Yellow Pigment	-	% minimum per manufacturer
Calcium Carbonate and Inert Filler (No. 200 [75 µm] sieve)	30.0% maximum	40.0% maximum

971-6.3 Binders: The manufacturer shall have the option of formulating the material according to his own specifications. However, the physical and chemical properties contained in this Specification shall apply regardless of the type of formulation used. The pigment, beads and filler shall be well dispersed in the resin. The material shall be free from all skins, dirt and foreign objects.

971-6.4 Physical Requirements: Sample specimens shall be prepared in accordance with ASTM D 4960, 8.

Procedure shall meet the following requirements:

Property	Test Method	Minimum	Maximum
Water Absorption	ASTM D 570	-	0.5%
Softening Point	ASTM D 36	190ºF [90ºC]	-
Low Temperature Stress Resistance	AASHTO T 250	Pass	-
Specific Gravity	Water displacement	1.87	2.3
Indentation Resistance	ASTM D 2240* Shore Durometer, A2	5	30
Impact Resistance	ASTM D 256, Method A	1.0 N·m	-
Flash Point	ASTM D 92	475ºF [245ºC]	-
*The durometer and panel shall be at 110ºF [45ºC] with a 4.4 lb [2.0 kg] load applied. Instrument measurement shall be taken after 15 seconds.			

971-6.4.1 Set To Bear Traffic Time: When applied at the temperatures and thickness specified by Section 711, the thermoplastic shall set to bear traffic in not more than two minutes.

971-6.4.2 Retroreflectivity: The white and yellow pavement markings shall attain an initial retroreflectance of not less than 300 mcd/lx·m^2 and not less than 250 mcd/lx·m^2, respectively. The retroreflectance of the white and yellow pavement markings at the end of the one year service life shall not be less than 150 mcd/lx·m^2.

971-6.4.3 Durability: Durability is the measured percent of thermoplastic material completely removed from the pavement. The thermoplastic material line loss must not exceed 5.0% at the end of the one year service life.

971-6.5 Glass Spheres: Glass spheres shall be Type 1 and meet the requirements of 971-2.

971-6.6 Sharp Silica Sand: Sharp silica sand used for bike lane symbols and pedestrian crosswalk lines shall meet the following gradation requirements:

Sieve Size	% Passing
20 [850 µm]	100
50 [300 µm]	0 to 10

971-6.7 Application Properties: The thermoplastic material shall readily apply and adhere to the existing traffic stripe at temperatures as recommended by the manufacturer from equipment approved by the Engineer to produce a line which shall be continuous and uniform in shape having clear and sharp dimensions at a minimum thickness as identified in the plans. No signs of moisture shall be visible on the pavement surface as determined in accordance with the binder manufacturer's recommendations.

The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line of the same material. Such new material shall bond itself to the old line in a manner such that no splitting or separation occurs.

Overlay stripe thicknesses shall be measured as specified in Section 711 for refurbishing of thermoplastic stripes.

971-6.8 Packing and Marking: The thermoplastic material shall be packed in suitable biodegradable or thermo-degradable containers which will not adhere to the product during shipment and storage. The container of thermoplastic material shall weigh approximately 50 lb [23 kg]. The label shall warn the user that the material shall be heated in the range as recommended by the manufacturer.

971-7 Preformed Thermoplastic Materials for Traffic Stripes.

971-7.1 General: Upon cooling to normal pavement temperature, these materials shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic. The manufacturer shall have the option of formulating the material according to his own specifications. However, the requirements delineated in this Specification and Section 711 shall apply regardless of the type of formulation used. The pigment, glass spheres, and filler shall be well dispersed in the resin. The material shall be free from all skins, dirt and foreign objects.

971-7.2 Composition: The preformed thermoplastic shall consist of high quality materials, pigments and glass spheres or other reflective material uniformly distributed throughout their cross-sectional area, with a reflective layer of spheres or other reflective material embedded in the top surface.

971-7.3 Glass Spheres: White and yellow material shall contain no less than 30% glass spheres by weight. The glass spheres shall meet the requirements of 971-2.

971-7.4 Color: Materials shall meet the performance requirements specified in 971-1 and the following additional requirements. The initial luminance factor, Cap Y, shall not be less than 55. The in-service luminance factor at the end of the three year service life shall not be less than the requirements in ASTM D 6628 when measured outside the wheel paths.

971-7.5 Physical Requirements: Laboratory samples shall be prepared in accordance with ASTM D 4960 and shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Softening Point	ASTM D 36	195ºF [90ºC]	-
Low Temperature Stress Resistance	AASHTO T 250	Pass	-
Indentation Resistance	ASTM D 2240* Shore Durometer, A2	40	75
Impact Resistance	ASTM D 256, Method A**	1.0 N·m	-

*The durometer and panel shall be at 110ºF [45ºC] with a 4.4 lb [2.0 kg] load applied. Instrument measurement shall be taken after 15 seconds.
**The test specimen for ASTM D 256 shall be 1 in. x 1 in. x 6 in. and shall not be notched.

971-7.5.1 Retroreflectivity: The white and yellow pavement markings shall attain an initial retroreflectance of not less than 300 mcd/lx·m^2 and not less than 250 mcd/lx·m^2, respectively. The retroreflectance of the white and yellow pavement markings at the end of the three year service life shall not be less than 150 mcd/lx·m^2. All pedestrian crosswalks, bike lane symbols and messages in a proposed bike lane shall attain initial retroreflectivity of not less than 275 mcd/lx·m^2.

971-7.5.2 Skid Resistance: The surface of the stripes and markings shall provide a minimum skid resistance value of 35 BPN (British Pendulum Number) when tested according to ASTM E 303. Bike lane symbols and pedestrian crosswalks shall provide a minimum skid resistance value of 55 BPN.

971-7.5.3 Durability: Durability is the measured percent of thermoplastic material completely removed from the pavement. The thermoplastic material line loss must not exceed 5.0% at the end of the service life.

971-7.6 Application Properties: Application properties shall meet the requirements of Section 711.

971-7.7 Packing and Labeling: The thermoplastic material shall be packaged in suitable biodegradable or thermo-degradable containers which will not adhere to the product during shipment and storage.

971-8 Thermoplastic Materials for Raised Rib Shoulder Warning Devices.

971-8.1 General: Upon cooling to normal pavement temperature, these materials shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic. The manufacturer shall utilize alkyd based materials only and have the option of formulating the material according to his own specifications. However, the requirements delineated in this Specification and Section 701 shall apply regardless of the type of formulation used. The pigment, glass spheres, and filler shall be well dispersed in the resin. The material shall be free from all skins, dirt and foreign objects.

971-8.2 Composition:

Component	Test Method	White	Yellow
Binder		20.0% minimum	20.0% minimum
TiO_2, Type II Ructile	ASTM D 476	10.0% minimum	-
Glass Spheres	AASHTO T 250	40.0% minimum	40.0% minimum
Yellow Pigment		-	% minimum per manufacturer
Calcium Carbonate and Inert Filler (-200 mesh [-75 µm] sieve)		30.0% maximum	37.5% maximum
Percentages are by weight.			

971-8.3 Glass Spheres: Glass spheres shall be Type 1 and meet the requirements of 971-2.

971-8.4 Physical Requirements: Laboratory samples shall be prepared in accordance with ASTM D 4960 and shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Water Absorption	ASTM D 570	-	0.5%
Softening Point	ASTM E 28	212ºF [100ºC]	-
Low Temperature Stress Resistance	AASHTO T 250	Pass	-
Specific Gravity	Water displacement	1.9	2.3
Indentation Resistance	ASTM D 2240* Shore Durometer, A2	65	-
Impact Resistance	ASTM D 256, Method A	10 inch pound [1.0 N·m]	-
Flash Point	ASTM D 92	475ºF [245ºC]	-
*The durometer and panel shall be at least 77ºF [25ºC], but not exceeding 86ºF [30°C] and a 4.4 lb [2 kg] load applied. After 15 seconds, the reading shall not be less than 65 units.			

971-8.4.1 Set To Bear Traffic Time: When applied at the temperatures and thickness specified by Section 711, the thermoplastic shall set to bear traffic in not more than 15 minutes.

971-8.4.2 Retroreflectivity: The white and yellow pavement markings shall attain an initial retroreflectance of not less than 300 mcd/lx·m^2 and not less than 250 mcd/lx·m^2, respectively. The retroreflectance of the white and yellow pavement markings at the end of the one year service life shall not be less than 150 mcd/lx·m^2.

971-8.4.3 Durability: Durability is the measured percent of thermoplastic material completely removed from the pavement. The thermoplastic material line loss must not exceed 5.0% at the end of the three year service life.

971-8.5 Application Properties: Application properties shall meet the requirements of Section 701.

971-8.6 Packing and Labeling: The thermoplastic material shall be packaged in suitable biodegradable or thermo-degradable containers which will not adhere to the product during shipment and storage. The container of thermoplastic material shall weigh approximately 50 lb [23 kg]. The label shall warn the user that the material shall be heated in the range as recommended by the manufacturer.

971-9 Materials for Inverted Profile, Wet Weather Traffic Stripes.

971-9.1 General: Upon cooling to normal pavement temperature, these materials shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic and draining water from the highway surface. The manufacturer shall utilize alkyd based materials only and have the option of formulating the material according to his own specifications. However, the requirements delineated in this Specification and Section 702 shall apply regardless of the type of formulation used. The pigment, glass spheres, and filler shall be well dispersed in the resin. The material shall be free from all skins, dirt and foreign objects.

971-9.2 Composition:

Component	Test Method	White	Yellow
Binder		20.0% minimum	20.0% minimum
TiO_2, Type II Ructile	ASTM D 476	10.0% minimum	N/A
Glass Spheres (intermix)	ASTM D 1155	40.0% minimum	40.0% minimum
Yellow Pigment		N/A	% minimum per manufacturer
Calcium Carbonate and Inert Filler (-200 mesh [-75 µm] sieve)		30.0% maximum	37.5% maximum
Lead	EPA Methods 3050 and 6010	3.0 ppm maximum	3.0 ppm maximum
Heavy Metals, Total (RCRA)	EPA Methods 3050 and 6010	100 ppm maximum	100 ppm maximum
Percentages are by weight.			

971-9.3 Glass Spheres: Glass spheres shall be determined by manufacturer's recommendations and meet the requirements of 971-2.

971-9.4 Physical Requirements: Laboratory samples shall be prepared in accordance with ASTM D 4960 and shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Water Absorption	ASTM D 570	-	0.5%
Softening Point	ASTM D 36	200ºF [93ºC]	-
Low Temperature Stress Resistance	AASHTO T 250	Pass	-
Specific Gravity	Water displacement	1.9	2.3
Indentation Resistance	ASTM D 2240* Shore Durometer, A2	45	-
Impact Resistance	ASTM D 256, Method A	10 in-lb [1.0 N·m]	-
Flash Point	ASTM D 92	475ºF [245ºC]	-
*The durometer and panel shall be at 90ºF [32ºC] with a 4.4 lb [2.0 kg] load applied. Instrument measurement shall be taken after 15 seconds.			

971-9.4.1 Set To Bear Traffic Time: When applied at the temperatures and thickness specified by Section 702, the striping material shall set to bear traffic in not more than two minutes.

971-9.4.2 Retroreflectivity: The white and yellow pavement markings shall attain an initial retroreflectance of not less than 300 mcd/lx·m^2 and not less than 250 mcd/lx·m^2, respectively. The white and yellow traffic stripes and markings will also attain an initial wet retroreflectivity of not less than 150 mcd/lx·m^2 and not less than 125 mcd/lx·m^2, respectively. The retroreflectance of the white and yellow pavement markings at the end of the three year service life shall not be less than 150 mcd/lx·m^2, also the wet retroreflectivity at the end of the service life shall not less than 75 mcd/lx·m^2.

971-9.4.3 Durability: Durability is the measured percent of thermoplastic material completely removed from the pavement. The thermoplastic material line loss must not exceed 5.0% at the end of the one year service life.

971-9.5 Application Properties: Application properties shall meet the requirements of Section 702.

971-9.6 Packing and Labeling: The thermoplastic material shall be packaged in suitable biodegradable or thermo-degradable containers which will not adhere to the product during shipment and storage. The container of thermoplastic material shall weigh approximately 50 lb [23 kg]. The label shall warn the user that the material shall be heated in the range as recommended by the manufacturer.

971-10 Permanent Tape Materials for Pavement Stripes and Markings.

971-10.1 General: The materials for pavement stripes and markings shall consist of white or yellow weather-resistant reflective film as specified herein. The markings are divided into two classes: Standard and High Performance. The classes are differentiated by their durability and retroreflectivity. The pigment, glass spheres, and filler shall be well dispersed in the resin. However, the requirements delineated in this Specification and Section 713 shall apply. The material shall be free from all skins, dirt and foreign objects.

971-10.2 Composition: The pavement stripes and markings shall consist of high-quality plastic materials, pigments, and glass spheres uniformly distributed throughout their cross-sectional area, with a reflective layer of spheres embedded in the top surface.

971-10.3 Skid Resistance: The surface of the stripes and markings shall provide a minimum skid resistance value of 35 BPN (British Pendulum Number) when tested according to ASTM E 303. Bike lane symbols and pedestrian crosswalks shall provide a minimum skid resistance value of 55 BPN.

971-10.4 Thickness: The Qualified Products List will list the specified thickness of each approved product.

971-10.5 Durability and Wear Resistance: When properly applied, the material shall provide neat, durable stripes and markings. The materials shall provide a cushioned resilient substrate that reduces sphere crushing and loss. The film shall be weather resistant and, through normal wear, shall show no significant tearing, rollback or other signs of poor adhesion. Durability is the measured percent of pavement marking material completely removed from the pavement. The pavement marking material line loss must not exceed 5.0% of surface area at the end of its service life.

971-10.6 Conformability and Resealing: The stripes and markings shall be capable of conforming to pavement contours, breaks and faults under traffic at pavement temperatures recommended by the manufacturer. The film shall be capable of use for patching worn areas of the same types of film in accordance with the manufacturer's recommendations.

971-10.7 Tensile Strength: The stripes and markings shall have a minimum tensile strength of 40 psi [275 kPa] when tested according to ASTM D 638. A rectangular test specimen 6 by 1 by 0.05 [150 by 25 by 1.5 mm] minimum thickness shall be tested at a temperature range of 40 to 80ºF [21 to 27ºC] using a jaw speed of 0.25 inch/min [6 mm/min].

971-10.8 Elongation: The stripes and markings shall have a minimum elongation of 25% when tested in accordance with ASTM D 638.

971-10.9 Plastic Pull test: The stripes and markings shall support a dead weight of 4 lb [1.8 kg] for not less than five minutes at a temperature range of 70 to 80ºF [21 to 27ºC].

Rectangular test specimen size shall be 6 by 1 by 0.05 inch [150 by 25 by 1.5 mm] minimum thickness.

971-10.10 Pigmentation: The pigment shall be selected and blended to provide a material which is white or yellow conforming to standard highway colors through the expected life of the stripes and markings.

971-10.11 Glass Spheres: The glass spheres shall meet the requirements of 971-2.

The stripes and markings shall have glass retention qualities such that, when at room temperature a 2 by 6 inches [50 by 150 mm] specimen is bent over a 0.5 inch [13 mm] diameter mandrel axis, a microscopic examination of the area on the mandrel shall show no more than 10% of the spheres with entrapment by the material of less than 40%. The bead adhesion shall be such that spheres are not easily removed when the film surface is scratched firmly with a thumbnail.

971-10.12 Standard Markings: The preformed materials for pavement stripes and markings shall have a service life of three year. The materials shall attain an initial retroreflectance of not less than 300 mcd/lx·m^2 and not less than 250 mcd/lx·m^2, respectively. The retroreflectance of the white, yellow and contrast pavement markings at the end of the three year service life shall not be less than 150 mcd/lx·m^2.

971-10.13 High Performance Markings: The preformed materials for pavement stripes and markings shall have a service life of five years. The materials shall attain an initial retroreflectance of not less than 450 mcd/lx·m^2 for white and contrast markings and not less than 350 mcd/lx·m^2 for yellow markings. The pavement stripes and markings shall retain a minimum retroreflectance for two years of not less than 300 mcd/lx·m^2 for white and contrast markings and not less than 250 mcd/lx·m^2 for yellow markings. The retroreflectance of the white, yellow and contrast pavement markings at the end of the five year service life shall not be less than 150 mcd/lx·m^2.

971-11 Two Reactive Component Materials For Traffic Stripes And Markings.

971-11.1 General: Two reactive component materials intended for use under this Specification shall include, but not be limited to, epoxies, polyesters and urethanes. Upon curing, these materials shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic. The manufacturer shall have the option of formulating the material according to his own specifications. However, the criteria outlined in this Specification and Section 709 shall apply regardless of the type of formulation used. In a cured condition, all of the products designated in this Specification shall be classified as non-hazardous waste as defined by 40 CFR 261.24 when tested in accordance with EPA Method 1311, Toxicity Characteristics Leaching Procedures (TCLP). The material shall not exude fumes which are toxic or detrimental to persons or property. The material shall be free from all skins, dirt and foreign objects.

971-11.2 Composition:

Component	Test Method	Criteria
TiO_2, Type II Rutile (white paint only)	ASTM D 476	minimum 10% by weight
Lead	EPA 1311 (TCLP)	maximum 0.15 ppm
Volatile Organic Content, (VOC)	ASTM D 3960	maximum 150 g/L

971-11.3 Pigment: The yellow pigment used shall not contain lead or any other Resource Recovery and Conservation Act (RCRA) materials.

971-11.4 Glass Spheres: Glass spheres shall be Type 1 and meet the requirements of 971-2.

971-11.5 Sharp Silica Sand: Sharp silica sand used for bike lane symbols and longitudinal lines shall meet the following gradation requirements:

Sieve Size	% Passing
20 mils [850 µm]	100
50 mils [300 µm]	0 to 10

971-11.6 Physical Requirements: The material shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Dry Opacity*	Fed Std 141a Method 4121	0.96	-
Bleed Ratio	Fed Spec TT-P-85D	0.95	-
Flexibility	Fed Spec TT-P-115D	Pass	-
Abrasion Resistance	971-12.6.3	Pass	-
*When applied at manufacturer's recommended dry film thickness.			

971-11.6.1 Set To Bear Traffic Time: When applied at the temperatures and thickness specified by Section 710, the material shall set to bear traffic in not more than two minutes.

971-11.6.2 Abrasion Resistance: Test four samples per LOT using a Taber Abrader. The paint shall be applied to specimen plates using a drawdown blade having a clearance of 26 mils [660 µm]. Air dry each sample for 30 minutes and bake at 220ºF [105ºC] for 18 hours. Clean with a soft brush and weigh each sample. Abrade samples for 1,000 cycles with 1.1 lb [500 g] weights and CS-10 wheels. Clean the samples with a soft brush and weigh again. The average weight loss for the four plates shall not exceed 0.178 oz [50 mg] per plate.

971-11.6.3 Retroreflectivity: The white and yellow pavement markings shall attain an initial retroreflectance of not less than 300 mcd/lx·m^2 and not less than 350 mcd/lx·m^2, respectively. The retroreflectance of the white and yellow pavement markings at the end of the one year service life shall not be less than 150 mcd/lx·m^2.

971-11.7 Application Properties: Application properties shall meet the requirements of Section 709.

971-11.8 Packaging and Labeling: The two reactive component material shall be placed in 55 gal [210 liter] open-end steel drums with a re-usable multi-seal sponge gasket. No more than 50 gal [190 liters] of material shall be placed in any drum to allow for expansion during transport and storage. Other containers will be used for applicable products. Each container shall designate the color, generic type (e.g. epoxy), user information, manufacturer’s name and address, batch number and date of manufacture. Each batch manufactured shall have a unique number. The label shall warn the user of hazards associated with handling or using the material.

971-11.9 Storage Life: Any material stored for less than one year not meeting these requirements shall be replaced at no cost to the Department.