

## SECTION 971 COATINGS AND TRAFFIC MARKING MATERIALS

### 971-1 General Requirements.

**971-1.1 Packaging and Labeling:** All coatings and traffic marking materials shall be shipped in strong containers plainly marked with the weight in pounds per gallon [kilograms per liter], the volume of coatings and 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.

**971-1.2 Storage:** Any coatings and 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 coatings and 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 except aluminum 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.

For aluminum paint, the aluminum paste and the varnish shall be packed separately.

**971-1.4 Qualified Products List:** All coatings and 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.

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 coating.

**971-1.5 Certification:** The Contractor shall provide the Engineer a certification conforming to the requirements of Section 6 from the manufacturer of the coatings and/or traffic marking materials confirming that the requirements of this Section are met. Each certification shall cover only one batch for coating and /or 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 Retroreflectivity:** Materials for traffic stripes or markings shall meet the Reflectivity requirements specified in the application requirements for that material (Section 709, Section 710, Section 711, or Section 713).

**971-1.8 Additional Requirements:** Coatings and 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.

Coatings shall contain less than 450 g/L Volatile Organic Compounds (VOC). Traffic strip materials shall contain less than 150 g/L VOC.

The presence of these compounds shall be tested for compliance by x-ray diffraction, ICP, or other methods capable of this level of detection. The material shall not exude fumes which are toxic or detrimental to persons or property.

### 971-2 Paint Schedule.

Applicable Specification(s)	Code	Color	Application
Steel			
971-5	Z-C	brown	Steel prime coat
971-6	B-8	lead gray	Third coat for steel
971-6	B-9	silver gray	Finish coat for steel - alternate
971-7	B-A	aluminum	Finish coat for steel
Wood			
971-9.1	W-1	white	Wood painting
971-9.2	W-7	black	Wood painting
Metal			
971-9.3	M-P	brown	Prime coat for galvanized metal
971-10	B-7	black	Finish coat for metal
971-15			Galvanizing Compound (Organic Zinc-rich coating) for Field Metalizing and Touch-up Repair
971-16			Self-Curing Inorganic Zinc Coating
Masonry			
971-11	CW-1	white	Masonry painting

### 971-3 Methods of Sampling and Testing.

**971-3.1 General:** Before the paint is used a sample shall be submitted for test. If approved, the sample will be used in determining the merits of the paint. All paints used shall equal the sample in color and quality. Code numbers shall be used in ordering and designating paints.

A pint [0.5 L] sample shall be taken from each LOT and batch delivered and shall be tested and approved before any paint is applied. Paint manufactured and sealed under State supervision may be used without further testing. Standard color chips of all paints are kept at the Materials Office, Gainesville, and may be obtained by manufacturers or other parties interested. All samples will be compared to these standards for color and any market deviation will be sufficient ground for rejection.

The Department may, at its discretion, place an Inspector at the place of manufacture of the paint. The paint manufacturer shall render all assistance and furnish all facilities for inspecting and testing the paint manufactured. This inspection is to facilitate testing and approval, but is not final, and the material must maintain its quality and working consistency at the time of use.

All materials and paints shall conform to these Specifications when analyzed by standard methods. Unless otherwise designated, a tolerance of 2% on weight in pounds per gallon [kilograms per liter], and an absolute tolerance of  $\pm 2\%$  on the percent pigment and the percent vehicle, may be allowed on small batches or LOTs of 50 gal [190 L] or less.

All paints and varnishes shall be filtered or clarified to the satisfaction of the Inspector before the filling of containers. All varnishes, after cooking, shall be allowed to cool and age at least seven days before being used.

**971-3.2 Volumetric Weights:** The weight in pounds per gallon [kilograms per liter] of varnishes, clear liquids, paints and enamels shall be determined in accordance with the applicable test methods of Federal Standard No. 141 (Test Methods) at 77°F [25°C], and the containers shall be filled by weight.

**971-3.3 Bulking Factor for Aluminum Paste:** Bulking factor for aluminum paste shall be taken as 0.086.

**971-3.4 Test Standards:** The following materials will be tested according to, and required to meet, the specified standards shown below:

Raw Tung Oil	FS TT-T-775
Raw Linseed Oil	ASTM D 234
Boiled Linseed Oil	ASTM D 260
Turpentine, gum spirits or steam distilled	ASTM D 13
Mineral Spirits	ASTM D 235
Thinner, Naphtha, low-boiling	FS TT-N 95 (Type I)
Lead Naphthenate	FS TT-D 643
Manganese Naphthenate	FS TT-D 643
Cobalt Naphthenate	FS TT-D 643
Liquid Drier	FS TT-D 651
Titanium Dioxide	ASTM D 476
Red Lead (95% grade)	ASTM D 83
Basic Carbonate White Lead	ASTM D 81
Leaded Zinc Oxide*	ASTM D 80
Basic Sulfate White Lead	ASTM D 82
Red and Brown Iron Oxide	ASTM D 3722
Magnesium Silicate	ASTM D 605
(Except Fe <sub>2</sub> O <sub>3</sub> shall be less than 0.4% and R <sub>2</sub> O <sub>3</sub> shall be less than 3.0%.)	
Carbon Black	ASTM D 561
Lampblack	ASTM D 209
Medium Chrome Yellow, and Orange	ASTM D 211
Zinc Chromate	ASTM D 478
Zinc Oxide, American Process	ASTM D 79
Mica, Water Ground, 325 [45 µm] sieve	ASTM D 607
Red Iron Oxide, 82 to 85%	FS TT-P 408
Zirconium Complex, Drier Catalyst, 6% Titanium Dioxide, Anatase	FS TT-P 442 (Type I)
Calcium Carbonate	ASTM D 1199 (Type GC)
Diatomaceous Silica	ASTM D 604 (Type A)
Xylene	ASTM D 846
Refined Solvent Naphtha	ASTM D 838
Note: FS = Federal Specification.	
*The manufacturer, at his option, may blend normal or basic lead sulfate with zinc oxide to provide, in the finished paint, the leaded zinc oxide required in ASTM D 80.	

#### 971-4 Inert Pigments.

Only barytes, barium sulphate (artificial), silica or magnesium silicate will be considered as suitable fillers. Inerts shall in no case contain organic coloring matter, soap or emulsifying agents. Tinting pigments shall be ground in oil before mixing with paint.

#### 971-5 Prime Coat for Painting Steel, Code Z-C.

##### 971-5.1 Composition:

Pigment	% by Weight	
	Minimum	Maximum
Zinc Chromate	7	9
Red Lead	15	-
Red Iron Oxide*, 82 to 85% TT-P 408	-	60
Mica, 325 [45 µm] sieve	15	17
Zinc Oxide	3	4
Vehicle		
Raw Linseed Oil	54	-
Processed Tung-Linseed**	18	20
Mineral Spirits	-	25
Cobalt Naphthenate***, 6%	Total drier not more than 1.8%	
Lead Naphthenate***, 24%		
Zirconium Complex***, 6%		
Anti-Skinning Agent	-	0.05
Pigment	54	56
Vehicle	44	46
*For 2-coat differentiation, a small quantity of lampblack shall be added to replace an equal volume of red iron oxide. The manufacturer, at his option, may blend iron oxide and magnesium silicate to provide in the finished paint the iron oxide content required in this Article.		
**Processed Tung-Linseed Oils: 40 parts, by weight, of Tung Oil and 60 parts, by weight, of Raw Linseed Oil are kettle-processed at 480°F [250°C] to a viscosity of Z-2 to Z-4 (Gardner). The processed oil shall not have a color greater than 11, nor an acid number greater than 3.0.		
***The Drier combination may be varied at the discretion of the supplier provided that the total driers as the metal do not exceed 0.30%, by weight, on the vehicle non-volatile basis.		

### 971-5.2 Physical Properties:

	Minimum	Maximum
Drying time, 100°F [38°C]	-	18 hours
Weight	13.0 lb/gal [1.56 kg/L]	-
Consistency, Krebs Units	75	88
Fineness of Grind, ASTM D1210	2 (HS)* [75 µm]	3 (HS)* [65 µm]
*HS is Hegman Scale.		

### 971-6 Third and Fourth Coats for Painting Steel, Codes B-8 and B-9.

**971-6.1 Tung Oil-Phenolic Varnish, 40 gallon [150 L] Oil Length:** The materials used in the manufacture of this varnish shall conform to the following:

Phenolic Resin: The resin used shall be a pure phenolic resin of the nonreactive type, and shall have the following properties:

Nonvolatile	100%
Color (USDA Resin Stand.)	M to I
Melting Range (Capillary Tube Method)	260 to 295°F [127 to 146°C]
Specific Gravity	1.04 to 1.10
Oil: The total oil content of this varnish shall conform to the following:	
Tung Oil, Pure, Raw	minimum 60%
Raw Linseed Oil (Co-processed with Tung Oil)	20%
Bodied Linseed Oil, "Q" Viscosity, (Chill-back)	20%
	100%

**971-6.2 Varnish Reduction:**

Oil Length	40 gal [150 L]
Thinner	Mineral Spirits
Nonvolatile	49 to 51%
Color	maximum 12
Viscosity (Gardner)	D to E
The reduced resin, prior to use, must be clear and free from "strings" and other foreign matter.	

**971-6.3 Composition:**

Pigment	% by Weight	
	Minimum	Maximum
35% Leaded Zinc Oxide	28	-
Titanium Dioxide, Rutile	12	14
Basic Carbonate White Lead	26	28
Mica, 325 [45 µm] sieve	12	13
Magnesium Silicate	-	18
Lampblack*	-	-
Vehicle		
Tung Oil Phenolic Varnish 50% Nonvolatile	68	70
Raw Linseed Oil	29	-
Mineral Spirits**	-	2
Cobalt Naphthenate, 6%	Total Drier 1.1% by weight	
Lead Naphthenate, 24%		
Anti-Skinning Agent	0.07	-
Total Pigment	56	57
Total Vehicle	43	44
*Lampblack: Sufficient lampblack is added to conform with the Standard Department of Transportation color chips for this paint, at the expense of magnesium silicate in the formulation. Code B-8 is designated as lead gray and Code B-9 is designated as silver gray.		
**Mineral Spirits: The small amount of mineral spirits indicated is in addition to that contained in the 50% nonvolatile varnish and is considered as being sufficient for small consistency adjustments.		

**971-6.4 Physical Properties:**

	Minimum	Maximum
Weight	13.5 lb/gal [1.62 kg/L]	-
Drying time, tack free, 100°F [38°C]	-	8 hours
Drying time, through dry, 100°F [38°C]	-	18 hours
Fineness of Grind, ASTM D 1210	2(HS)* [75 µm]	3(HS)* [65 µm]
Consistency, Krebs Units	78	88
*HS is Hegman Scale.		

### 971-7 Fourth Coat for Steel, Code B-A.

**971-7.1 Pigment:** The pigment shall consist of aluminum paste conforming to Federal Specification TT-P 320, Type II, Class B.

**971-7.2 Varnish Vehicle:** The varnish vehicle shall conform to Federal Specification TT-V 81, Type II, Classes A and B.

**971-7.3 Proportions:** 2 lb [0.24 kg] of aluminum paste shall be mixed with 1 gal [1 liter] of the above varnish.

**971-7.4 Packaging:** This paint shall be packaged in a 2-compartment container, with varnish in one compartment and paste in the other, sufficient to make 5 gal [20 L] of the mixed paint.

**971-7.5 Drying Time:** The mixed aluminum paint shall set to touch in not less than two hours nor more than six hours, 100°F [38°C] on metal, and shall dry hard and tough in not more than 24 hours.

**971-7.6 Mixing:** The aluminum paint shall be freshly mixed and only enough for one day's use shall be mixed at one time. Any paint remaining after this period may be mixed with freshly prepared paint if it does not exceed 10% of the total newly mixed paint.

### 971-8 Shop and Field Paint for Grating.

**971-8.1 General:** The coating used to paint gratings and frames shall be a product on the Qualified Products List.

**971-8.2 Composition:** The composition of the paint shall be left to the discretion of the manufacturer with the exception of the following requirements:

- Lead or chromium pigments shall not be used in the manufacture of the paint.
- The volatile organic content (V.O.C.) of the paint shall not exceed 150 g/L.

**971-8.3 Corrosion Tests:** Products submitted for inclusion on the Qualified Products List shall comply with the requirements listed below. Clean cold rolled steel panels 3 by 8 inches by 0.032 inch thick [75 by 200 mm by 0.81 mm thick] with the number of dip coats and thickness of each coat applied according to the manufacturer's recommendations. A notation of the number of coats and the thickness of each coat at which the product passed testing will be placed on the Qualified Products List. This will be the minimum criteria for application of the coating as part of a FDOT project.

	Exposure Time	ASTM D 610 Minimum Rust Grade
a. 100% Relative Humidity (75 to 90°F [(24 to 32°C), ASTM D 2247)	600 hours	8
b. Inland Test Rack	12 months	8
Material Safety Data Sheets shall accompany all products submitted for testing.		

**971-8.4 Samples and Certification of Tests:** Paint samples will be obtained in accordance with the Department's sampling, testing and reporting guide schedule. For each batch of paint used, the Contractor shall furnish to the State Materials Engineer three certified copies of test reports that show the following paint analysis data:

- a. Weight per gallon at 77°F [liter at 25°C] (ASTM D 1475).
- b. Volatile organic content (V.O.C. ASTM D 3960).
- c. Consistency in Krebs Units at 77°F [25°C] (ASTM D 562).
- d. Weight percent pigment (ASTM D 3723).
- e. Weight percent total solids (ASTM D 2369).
- f. Drytime to handle and topcoat.
- g. Shelf life.

**971-9 Codes W-1, W-7, and M-P.**

**971-9.1 Code W-1:**

**971-9.1.1 General:** Paint for all white painting of wood shall conform to the Specifications shown below.

**971-9.1.2 Pigment Composition:**

	% by Weight	
	Minimum	Maximum
Rutile Titanium Dioxide	23	-
Anatase Titanium Dioxide	8	-
Zinc Oxide	27	-
Calcium Carbonate	-	23
Magnesium Silicate	-	19

**971-9.1.3 Vehicle Composition:**

	% by Weight	
	Minimum	Maximum
Linseed Oil*	3	4
Isophthalic Alkyd Resin**	53	56
Mineral Spirits	-	40
Mercuric Mildewcide (10% Mercury content)	1.3	1.4
24% Lead Naphthenate	1.15	
6% Cobalt Naphthenate	0.175	
6% Manganese Naphthenate	0.233	
Anti-skinning Agent	0.2	-
*Linseed Oil:		
Viscosity (Gardner)	Z- 2 to Z-3	
Acid Number, maximum	10	
**Isophthalic Alkyd Resin:		
Fatty Acids, minimum	76%	
Isophthalic Acid, minimum	16%	
Viscosity at 70% Solids, Gardner-Holt N to O		
Acid Value, on solids	3 to 5	
Color, Hellige, maximum	9	

**971-9.1.4 Physical Properties:**

	Minimum	Maximum
Pigment, by weight	53%	66%
Vehicle, by weight	45%	47%
Weight	12.3 lb/gal [1.47 kg/L]	12.7 lb/gal [1.52 kg/L]
Consistency, Krebs Units	78	82
Drying Time at 100°F [38°C]	-	6 hours

**971-9.2 Code W-7:** Paint for all black painting on wood shall conform to the following specifications:

- Pigment ..... 28 to 32% by weight
- Vehicle ..... 68 to 72% by weight
- Volatile Matter (% of vehicle), not over ..... 20% by weight
- Weight ..... Not less than 9.0 lb/gal [1.08 kg/L]
- Drying time, 100°F [38°C], on metal ..... Under 18 hours
- Vehicle, over 80% raw linseed oil.
- Thinner to be turpentine.
- Pigment Composition:
- Carbon, not less than ..... 20% by weight
- Red Lead, not less than ..... 5% by weight
- Inert (Oxide of Iron, Class III, Type B, and Fillers),  
not less than ..... 6% by weight

**971-9.3 Code M-P:** When specified, galvanized metal surfaces, after being washed with vinegar solution (one part vinegar to six parts water) and allowed to dry, shall be given one coat of metal primer conforming to the following specifications:

- Pigment ..... 45% by weight
- Vehicle ..... 55% by weight
- (Vehicle shall be linseed oil and varnish type)
- Volatile Matter (% of vehicle) ..... 10 to 25% by weight
- Weight ..... 11.5 lb/gal [1.38 kg/L]
- Drying time, free from tack, 100°F [38°C], on metal ..... under six hours.
- Pigment Composition:
- Iron Oxide, Class I ..... 23% by weight
- Medium Chrome Yellow, Type III ..... 25% by weight
- Inert and Tinting Pigment ..... 52% by weight
- (This primer is not intended to be a heavy bodied paint. The color is not important).

**971-10 Finish Coat for Metal, Code B-7.**

This paint shall be a graphite paint. The pigment in both semi-paste and ready-mixed paint shall consist of a finely ground graphite carbon and insoluble siliceous matter. The graphite carbon may be derived from either natural or artificial graphite, and the insoluble siliceous matter may be either the natural-occurring insoluble impurities of the graphite or added insoluble siliceous matter. The pigment shall show the following analysis:



Graphite Carbon, not less than.....50% by weight  
 Insoluble Siliceous Matter, not less than .....30% by weight  
 Sum of Graphite Carbon and Insoluble Siliceous Matter,  
 not less than .....85% by weight  
 Calcium and Magnesium Carbonates and Sulphates,  
 not more than .....5% by weight  
 The pigment shall be ground so that 100% will pass the No. 200 [75 µm] sieve.  
 Graphite Pigment (as above specified) ..... 6 lb [2.72 kg]  
 Linseed Oil Vehicle ..... 1 gal [3.8 L]  
 Total volume of paint produced, approximately ..... 1.24 gal [4.7 L]  
 Weight of mixed paint (after thinner and dryer added),  
 minimum .....9.5 lb/gal [1.14 kg/L]  
 Drying time, 77°F [38°C], on metal ..... Under 18 hours

Raw linseed oil, or a mixture of raw and boiled oils containing not more than 25% of boiled oils, shall be used as a vehicle, except for work exposed to water action, in which case boiled linseed oil shall be used.

**971-11 White-Cement Water Paint, Code CW-1.**

**971-11.1 Composition:** This paint is an 80% white portland cement paint for general use on porous surfaces of masonry, concrete, stucco, common brick, masonry block and rough plaster (except gypsum plaster). It shall have no siliceous aggregate added. This Specification applies to hydraulic base paints, designed for use on the surfaces designated above as a decorative, protective and water-repellent coating. The white-cement water paint powder shall consist of white portland cement and titanium dioxide and may or may not contain hydrated lime. Water repellents (calcium or aluminum stearate) and hygroscopic salts (calcium or sodium chloride) shall be present. The paint shall contain no organic binder. It shall show on analysis:

	% by Weight	
	Minimum	Maximum
Portland Cement	-	80
Hydrated Lime*	10	-
Carbonated (Calculated as Carbon Dioxide)	3	-
Titanium Dioxide	5	3
Water Repellents (Calcium or Aluminum Stearate)	1	0.5
Hygroscopic Salts (Calcium or Sodium Chloride)	5	-
The total free (unhydrated) calcium oxide and magnesium oxide in the hydrated lime shall not exceed 8%, by weight, of the hydrated lime.		

**971-11.2 Physical Requirements:** The material shall be in powder form, free from any lumps that are not easily friable and shall mix with water in proportion of 100 cm<sup>3</sup> (100 mL) of powder to 100 mL of water to form, after five minutes stirring, a paint showing no unwetted pigment particles. This paint, when applied to damp porous concrete with a fiber brush, and allowed to stand 18 hours in an atmosphere free of chemical fumes at a temperature of 70 to 75°F [21 to 24°C] and relative humidity of 50 to 55%, shall dry to a hard, opaque, flat finish of uniform color that will not powder, chip or rub off.

**971-11.3 Methods of Sampling:** The methods of sampling, inspection and tests shall be in accordance with Federal Specification TT-P-21.

**971-11.4 Shipping Containers:** Unless otherwise specified, commercial shipping containers shall be moisture proof and marked with the name of the material, the size, mixing directions,

specification number, and the quantity contained therein, as defined by the contract or order number under which the shipment is made, and the number of the contract or order.

**971-12 Two Reactive Component Materials For Traffic Stripes And Markings.**

**971-12.1 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, Section 709 and FM 5-541 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.

**971-12.2 Composition:**

Component	Test Method	Criteria
TiO <sub>2</sub> , 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

**971-12.3 Pigment:** The yellow pigment used shall not contain lead or any other Resource Recovery and Conservation Act (RCRA) materials.

**971-12.4 Glass Spheres:** Glass spheres shall have an index of refraction of 1.5 or greater. The glass spheres shall meet the requirements of AASHTO M 247, Type I.

**971-12.5 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

**971-12.6 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.

**971-12.6.1 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.

**971-12.6.2 Color:**

Property	White	Yellow	Black
RD* (Fed Std 141a)	minimum 87%	minimum 43%	-
Color, Visual Match (Fed Std 595a)	Color No. 37875	Color No. 33538	Color No. 37038

\*After four hour ambient dry and 24 hour oven dry at 150°F [66°C].

The color of the yellow thermoplastic material shall meet the following criteria:

Initial reflectance ..... 43% minimum

Initial chromaticity of the cured yellow traffic paint shall fall within the area

bordered by the following coordinates:

X	0.455	0.510	0.472	0.530
Y	0.444	0.485	0.400	0.456

The retained color of the yellow chromaticity coordinates, shall fall within the following limits:

Chromaticity Coordinates (x,y)\*\*

X	0.435	0.51	0.449	0.53
Y	0.429	0.485	0.377	0.456

\*\*Chromaticity shall fall in an area bordered by these coordinates of a beaded yellow line (for the life of the Reflectivity performance when measured in accordance with Florida Test Method FM 5-541) when measured with a BYK Gardner Catalog No. 9200 Handy-Color Colorimeter or approved equal by the State Materials Office in accordance with Florida Test Method FM 5-541.

**971-12.6.3 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 220°F [105°C] 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.

**971-12.7 Application Properties:** Application properties shall meet the requirements of Section 709.

**971-12.8 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.

**971-12.9 Storage Life:** Any material stored for less than one year not meeting these requirements shall be replaced at no cost to the Department.

### 971-13 Fast Dry Solvent Traffic Paint.

**971-13.1 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, Section 710, and FM 5-541 shall apply regardless of the type of formulation used. The material shall be free from all skins, dirt and foreign objects.

**971-13.2 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 <sub>2</sub> , 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

**971-13.3 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

**971-13.4 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 170°F [77°C]	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	-

**971-13.4.1 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.

**971-13.4.2 Color:**

Property	White	Yellow	Black
RD* (Fed Std 141a)	minimum 87%	minimum 43%	-
Color, Visual Match (Fed Std 595a)	Color No. 37875	Color No. 33538	Color No. 37038

\*After four hour ambient dry and 24 hour oven dry at 150°F [66°C].

The color of the yellow thermoplastic material shall meet the following criteria:

Initial reflectance ..... 43% minimum

Initial chromaticity of the cured yellow traffic paint shall fall within the area

bordered by the following coordinates:

X	0.455	0.510	0.472	0.530
Y	0.444	0.485	0.400	0.456

The retained color of the yellow chromaticity coordinates, shall fall with the following limits:

Chromaticity Coordinates (x,y)\*\*:

X	0.435	0.51	0.449	0.53
Y	0.429	0.485	0.377	0.456

\*\*Chromaticity shall fall in an area bordered by these coordinates of a beaded yellow line (for the life of the Reflectivity performance when measured in accordance with Florida Test Method FM 5-541) when measured with a BYK Gardner Catalog No. 9200 Handy-Color Colorimeter or approved equal by the State Materials Office in accordance with Florida Test Method FM 5-541.

**971-13.4.3 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 220°F [105°C] 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.

**971-13.5 Application Properties:** Application properties shall meet the requirements of Section 710.

**971-13.6 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.

### 971-14 Glass Spheres (for Reflective Pavement Marking Striping Systems).

**971-14.1 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 applies to glass spheres.

The glass spheres shall conform to the requirements of AASHTO M 247, Type I with moisture resistant coating or a formulation specified by the traffic striping material manufacture and be one of the gradation, index of refraction and formulations included on the Qualified Products List (QPL).

**971-14.2 Specific Properties:** The glass spheres shall have an adhesion coating that will promote adhesion and proper embedment in the binder for optimum retroreflective performance. The general requirements of AASHTO M 247 Part 2 and the following physical requirements apply:

Property	Test Method	Specification
Gradation	ASTM D 1214	AASHTO M 247, Type 1
Roundness	ASTM D 1155	Min: 70% true spheres by weight per sieve size
Refractive Index	Becke Line Method (25+/-5 C)	1.5 minimum

### 971-14.3 Surface Application Spheres:

**971-14.3.1 Rate of Application:** The glass spheres shall be applied at the rate of 6 lb [0.7 kg] of glass spheres per gallon [liter] of pigmented binder.

**971-14.3.2 Sampling:** A random 50 lb [23 kg] sample of glass spheres shall be obtained for each 50,000 lb [4,600 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.

**971-14.3.3 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.

## **971-15 Galvanizing Compound (Organic Zinc-Rich Coating) for Field Metalizing and Touch up Repair.**

**971-15.1 Composition and Proportions:** Galvanizing compound for the metalizing of welded areas and for repairing of damaged galvanized areas shall consist of at least 80% pigment and not more than 20% vehicle, and shall meet the following composition requirements for each.

Composition of Pigment:

Zinc dust (ASTM D 520, Type II)..... minimum 99.0%

Composition of Vehicle:

Non-Volatile vehicle..... minimum 22.0%

Volatile vehicle.....maximum 78.0%

The volatile portion of the vehicle shall be completely compatible with the other ingredients of the finished product and shall yield a product conforming to all physical and chemical properties required for the end product.

### **971-15.2 Physical Properties:**

(a) The weight of the finished product shall be at least 22 lb/gal [2.6 kg/L].

(b) The consistency of the compound, when measured at 77°F [25°C], shall be 90 to 130 Krebs Units (as measured by the Stormer Viscometer).

(c) There shall be no appreciable gassing or pressure build-up in the container when material is stored at room temperature for a three month period.

(d) The pigment component of the ready-mixed compound shall not settle when the package remains unopened for a period of one year, to the extent that it cannot be readily dispersed by hand mixing. The liquid vehicle shall not liver, curdle, or show excessive bodying.

### **971-15.3 Application, Drying, etc.:**

**971-15.3.1 Application:** The material shall be capable of being applied in the manner specified, without undue difficulty, in horizontal, vertical or overhead positions, such as would be required in the repairing of galvanized areas or in the galvanizing of welds.

**971-15.3.2 Drying time:** The compound shall set to touch in 30 minutes and shall be dry to re-coat in 12 hours. It shall be thoroughly hard within 48 hours after application.

**971-15.3.3 Dry Film Thickness (DFT):** Apply to achieve DFT annotated on the Qualified Products List.

**971-15.3.4 Adhesiveness:** Test panels coated according to the field application specifications shall be exposed to the weather for a period of at least three months, in a position of 45 degrees to vertical, facing south. At the end of this period, the test panels shall show no visible signs of peeling or of flaking.

**971-15.4 Packaging and Storing:** For containers of less than 1 gal [4 L] in content, commercial paint packaging will be acceptable. For 1 gal [4 L] packages, steel pails with metal thickness of 26 gauge [455 µm] shall be used. Not more than 1 gal [4 L] of compound covered by these Specifications shall be packed in a single container.

The compound shall be stored in a location where the temperature does not drop below 45°F [7°C].

**971-15.5 Test Requirements:** Certified copies of manufacturer's tests, certifying that the material meets the above specifications, may be accepted in lieu of tests by the Department.

## **971-16 Self-Curing Inorganic Zinc Coating.**

**971-16.1 Materials- Certification of Tests:** The producer of the paints described in this Article shall furnish to the Department three copies of a certified report outlining the paint composition characteristics specified in 971-16.2.2 and the results of the physical tests specified in 971-16.2.3.1 and 971-16.2.3.2. Final acceptance, however, will be based on test results of samples obtained after delivery of the paint to the job site. The test results must conform to the values and tolerances obtained for the products when they were initially qualified. The quality control field sample tests performed shall include the following:

(1) Infrared identification curves for zinc coating vehicle component, the intermediate coat vehicle component and the finish coat vehicle component.

(2) Weight, in pounds per gallon [kilograms per L] at 77°F [25°C], for the mixed zinc primer coat, the intermediate coat and the finish coat.

(3) Consistency, in Krebs Units at 77°F [25°C], for the mixed zinc primer coat, the intermediate coat, and the finish coat.

(4) Weight percent volatile liquid of the mixed zinc primer coat, the intermediate coat and the finish coat.

(5) Weight percent of metallic zinc in the cured zinc primer coat dry film.

(6) Weight percent of metallic zinc in the zinc pigment component.

(7) Pot life of the mixed zinc primer.

### **971-16.2 Testing:**

**971-16.2.1 General:** Manufacturers or distributors seeking approval of self-curing inorganic zinc coating systems for inclusion on the qualified products list shall comply with the requirements specified below.

Approval will be granted for qualifying products upon submission of the required samples and information and after tests have verified that those products submitted for a particular coating system are satisfactory.

**971-16.2.2 Information to Accompany Samples:** Products submitted for approval shall be accompanied by a notarized letter giving the following information:

(1) Copies of the infrared curves (2.5 to 15  $\mu\text{m}$ ) for the zinc coating vehicle component, the intermediate coat vehicle and the finish coat vehicle.

(2) Weight, in pounds per gallon [kilograms per liter] at 77°F [25°C], for the mixed zinc primer coat, the intermediate coat and the finish coat.

(3) Consistency, in Krebs Units at 77°F [25°C], for the mixed zinc primer coat, the intermediate coat, and the finish coat.

(4) The theoretical number of square feet [square meters] that can be covered per gallon [4 L] to a dry film thickness of 1 mil [25  $\mu\text{m}$ ] for the mixed zinc primer coat, intermediate coat, and the finish coat.

(5) Total volume solids (Volatile Measurement Method) of the mixed zinc primer coat, the intermediate coat and the finish coat.

(6) Generic classification of the mixed zinc primer coat, the intermediate coat and the finish coat.

(7) Weight percent solids of the generic classified components for the zinc primer, intermediate and the finish coat vehicles.

(8) Weight percent volatile liquid of the mixed zinc primer coat, the intermediate coat and the finish coat.

(9) Weight percent of metallic zinc in the cured zinc primer coat dry film.

(10) Pot life of the mixed zinc primer.

(11) Weight percent of metallic zinc in the zinc pigment component.

(12) Application and thinning instructions.

### **971-16.2.3 Tests:**

**971-16.2.3.1 Resistance Tests:** Test panels for the test described below shall be prepared by applying the inorganic zinc primer to near white metal blasted steel coupons (SSPC-SP10-63, 1 to 1.5 mil [25 to 38  $\mu\text{m}$ ] profile) and allowing to dry for 24 hours at 77°F [25°C] and 50% RH. The dry film thickness of the coating shall be not less than 3 mils [75  $\mu\text{m}$ ] nor more than 5 mils [125  $\mu\text{m}$ ].

(1) When tested for abrasion resistance in accordance with Federal Standard 141-a, Method 6192, using CS-17 wheels and a 1,000 g load per wheel, the cured coating shall show a maximum loss of 0.2 g per thousand cycles.

(2) The cured coating shall show no loss of adhesion or hardness and shall display no flaking or cracking when held at 600°F [315°C] for three hours.

(3) The cured film shall show no flaking, blistering, cracking or loss of adhesion after being wrapped in two 0.25 inch [6 mm] thick layers of cotton wadding and saturated with tap water for 8 hours.

(4) The cured coating, diagonally scribed to expose bare steel, when tested for salt spray resistance in accordance Federal Standard 141-a Method 6061, shall show no corrosion after 1,000 hours of test. The corrosive medium shall be a 5% sodium chloride solution.

(5) The cured coating, diagonally scribed to expose bar steel and exposed to flowing tap water at 73°F [23°C], shall show no scribe corrosion, blistering, loss of adhesion or cracking after 1,000 hours test. Test panels shall be completely immersed in a suitable container of at least 5 gal [20 L] capacity with fresh water inlet and outlet which will accomplish water change at a rate not less than 15 gal/h [57 L/h].

(6) The cured coating, diagonally scribed and completely immersed for four weeks at 73°F [23°C] in a 3% solution of aerated synthetic sea water ("Sea Salt," Lake Products Co., St. Louis, Missouri), shall show no scribe corrosion, blistering, cracking, or loss of adhesion. Aeration shall be accomplished by bubbling compressed air into the solution at a rate sufficient to accomplish moderate agitation of the liquid. At least 5 gal [20 L] of solution shall be used in performing this test.

**971-16.2.3.2 Adhesion Tests:** Test panels consisting of the zinc primer coat plus the tie coat, the zinc coat plus the finish coat; and the zinc primer coat plus the tie and finish coats shall be subjected to the adhesion tests described below. The zinc primer coat shall be applied as specified in 971-16.2.3.3. The tie coat application on the zinc primer-tie coat panel and the zinc primer-tie coat finish coat panel shall have a dry film thickness of 1 to 2 mils [25 to 50  $\mu\text{m}$ ]. The finish coat application on the zinc primer-finish coat panel and the zinc primer-tie coat-finish coat panel shall have a dry film thickness of 3 to 5 mils [75 to 125  $\mu\text{m}$ ]. Drying of the tie coat and the finish coat application shall be done at a temperature of 77°F [25°C] and relative humidity of 50 to 85%. All of the prepared panels shall be allowed to dry a minimum of 72 hours before proceeding with the adhesion test.

(1) No chipping, flaking or peeling of the tie coat or finished coat shall occur when cross hatches 0.06 inch [1.5 mm] apart are cut in all of the test panels.

(2) When all of the test panels cross hatched in the manner described above are tested with the point of a knife blade, no lifting of the tie coat or finish coat shall occur.

(3) Adhesion of the tie coat to the primer shall not be decreased upon application of the finish coat, and adhesion tested by knife-point shall be equivalent to that observed with the tie coat alone over the primer.

**971-16.2.3.3 Field Qualification:** Manufacturers or distributors seeking approval of the self-curing inorganic zinc coating system shall demonstrate the application characteristics of their products by painting approximately 500 ft<sup>2</sup> [50 m<sup>2</sup>] of steel girders under a bridge selected by the Department which shall be located in a coastal salt water environment zone. The recommended zinc primer shall be applied over the entire area to be painted. A one-third section of the primed area shall be painted with tie coat and finish coat (Three Coat System). Another one-third section of the primed area shall be painted with finish coat only (Two Coat System). The field demonstration shall include the following:



(1) Steel surfaces shall be blast cleaned using 30 by 65 mesh [230 by 600  $\mu\text{m}$ ] silica sand to a "Near White" condition as defined in SSPC-SP10-63. The "Near White" blast condition shall be determined by use of NACE No. 2 Visual Standard TM-01-70 or equal approved by the Department. After blast cleaning, the anchor pattern shall be from 1 to 2 mils [25 to 50  $\mu\text{m}$ ] deep in a dense and uniform pattern of depression and ridges as determined by use of the Keane-Tator Surface Profile Comparator or equal approved by the Department.

(2) The zinc primer coat shall be applied as recommended by the manufacturer in a single application employing multiple spray "passes" to achieve a dry film thickness of 3 to 5 mils [75 to 125  $\mu\text{m}$ ] above the anchor pattern. The dry film thickness shall be determined by use of an Inspector Magnetic Dry Film Thickness Gauge or equal approved by the Department. Prior to use, the magnetic dry film thickness gauge shall be calibrated with NBS No. SRM 1362 certified coating thickness calibration standards. The applied coating shall be considered deficient in thickness if the measured values are found to be less than 3 mils [75  $\mu\text{m}$ ] plus 30% of the anchor pattern depth obtained during the abrasive cleaning operation. Products that cannot be applied to build a dense and uniform coating shall be considered unacceptable by the Department. Products exhibiting "mudcracking" after curing shall also be considered unacceptable by the Department. The zinc primer coat shall be allowed to dry a minimum of 24 hours before application of the tie coat or finish coat.

(3) The intermediate tie coat shall be applied in a single application employing multiple spray passes to achieve a dry film thickness of 1 to 2 mils [25 to 50  $\mu\text{m}$ ]. The color of the tie coat shall contrast with both the color of the primer coat and the color of the finish coat.

(4) The finish coat shall be applied as recommended by the manufacturer in a single application employing multiple spray "Passes" to achieve a minimum dry film thickness of 3 mils [75  $\mu\text{m}$ ]. The color of the finish coat shall contrast with both the color of the primer coat and the color of the intermediate coat. Finish coat products that exhibit "bubbling" or a non-uniform appearance after drying shall be considered unacceptable by the Department.

(5) The Department shall obtain a 1 qt [1 L] field sample of each product included in the application for subsequent laboratory examination by the Department's Central Laboratory.

(6) Each of the applied coating systems shall remain exposed to weathering for a period of three years at which time there shall be no evidence of blistering, cracking, peeling or loss of adhesion between coats and there shall occur not more than 1% of area rusting in each of the test sections painted.

## **971-17 Thermoplastic Materials for Traffic Stripes.**

**971-17.1 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, Section 711, and FM 5-541 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.

### **971-17.2 Composition:**

Component	Test Method	White	Yellow
Binder		18.0% minimum	18.0% minimum
TiO <sub>2</sub> , Type II Rutile	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)		32.0% maximum	39.5% maximum

Percentages are by weight.

**971-17.3 Glass Spheres:** Glass spheres shall meet the requirements of 971-14.

**971-17.4 Sharp Silica Sand:** Sharp silica sand used for transverse lines, bike lane symbols and longitudinal lines shall meet the following gradation requirements:

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

**971-17.5 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	195°F [90°C]	-
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	475°F [245°C]	-

\*The durometer and panel shall be at 110°F [45°C] with a 4.4 lb [2.0 kg] load applied. Instrument measurement shall be taken after 15 seconds.

**971-17.5.1 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.

**971-17.5.2 Color:** The white thermoplastic material shall be pure white and free from any tint. Using a Hunter tristimulus colorimeter or approved equivalent in accordance with ASTM D 4960, the material shall not show deviations from magnesium oxide color standard greater than the following:

Scale Definition	Magnesium Oxide Standard	Sample
RD	100.0%	75.0% minimum
Reflectance		
a. Red-Green	0	-5 to +5
b. Yellow-Blue	0	-10 to +10

The color of the yellow thermoplastic material shall meet the following criteria:  
 Initial reflectance ..... 43% minimum  
 Initial chromaticity shall fall within the area bordered by the following

coordinates:

X	0.455	0.510	0.472	0.530
Y	0.444	0.485	0.400	0.456

The retained color of the yellow chromaticity coordinates, shall fall within the following limits:

Chromaticity Coordinates (x,y)\*\*:

x	0.435	0.51	0.449	0.53
y	0.429	0.485	0.377	0.456

\*\*Chromaticity shall fall in an area bordered by these coordinates of a beaded yellow line (for the life of the reflectivity performance when measured in accordance with Florida Test Method FM 5-541) when measured with a BYK Gardner Catalog No. 9200 Handy-Color Colorimeter or approved equal by the State Materials Office in accordance with Florida Test Method FM 5-541.

**971-17.6 Application Properties:** Application properties shall meet the requirements of Section 711.

**971-17.7 Packing and Labeling:** The thermoplastic material shall be packaged in suitable biodegradable or thermodegradable 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.

**971-18 Preformed Materials for Pavement Stripes and Markings.**

**971-18.1 General:** The preformed materials for pavement stripes and markings shall consist of white or yellow weather-resistant reflective film as specified herein. The pigment, glass spheres, and filler shall be well dispersed in the resin. However, the requirements delineated in this specification, Section 709, and FM 5-541 shall apply. The material shall be free from all skins, dirt and foreign objects.

**971-18.2 Composition:** The preformed 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.

**971-18.3 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.

**971-18.4 Color:** The white preformed materials shall be pure white and free from any tint. Using a Hunter tristimulus colorimeter or approved equivalent in accordance with ASTM D 4960, the material shall not show deviations from magnesium oxide color standard greater than the following:

Scale Definition	Magnesium Oxide Standard	Sample
RD	100.0%	75.0% minimum
Reflectance		
a. Red-Green	0	-5 to +5
b. Yellow-Blue	0	-10 to +10

The color of the yellow preformed material shall meet the following criteria:  
 Initial reflectance ..... 43% minimum  
 Initial chromaticity shall fall within the area bordered by the following coordinates:

x	0.455	0.510	0.472	0.530
y	0.444	0.485	0.400	0.456

The retained color of the yellow chromaticity coordinates, shall fall within the following limits:

Chromaticity Coordinates (x,y)\*\*:

X	0.435	0.51	0.449	0.53
Y	0.429	0.485	0.377	0.456

\*\*Chromaticity shall fall in an area bordered by these coordinates of a beaded yellow line (for the life of the reflectivity performance when measured in accordance with Florida Test Method FM 5-541) when measured with a BYK Gardner Catalog No. 9200 Handy-Color Colorimeter or approved equal by the State Materials Office in accordance with Florida Test Method FM 5-541.

**971-18.5 Thickness:** The preformed materials shall range in thickness from 20 to 90 mils [0.508 to 2.286 mm]. The Qualified Products List will list the specified thickness of each approved product.

**971-18.6 Durability and Wear Resistance:** When properly applied, the preformed material shall provide neat, durable stripes and markings. The preformed 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.

**971-18.7 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.

**971-18.8 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 80°F [21 to 27°C] using a jaw speed of 0.25 inch/min [6 mm/min].

**971-18.9 Elongation:** The stripes and markings shall have a minimum elongation of 25% when tested in accordance with ASTM D 638.

**971-18.10 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 80°F [21 to 27°C]. Rectangular test specimen size shall be 6 by 1 by 0.05 inch [150 by 25 by 1.5 mm] minimum thickness.

**971-18.11 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.

**971-18.12 Glass Spheres:** The glass spheres shall meet the requirements of 971-14.

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.

**971-19 Fast Dry Traffic Paint - Water Borne.**

**971-19.1 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, Section 710, and FM 5-541 shall apply regardless of the type of formulation used. The material shall be free from all skins, dirt and foreign objects.

**971-19.2 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 <sub>2</sub> , Type II Rutile (white paint only)	ASTM D 476	minimum 1.5 lb/gal [0.18 kg/L]
Volatile Organic Content, (VOC)	ASTM 3960**	maximum 150 g/L
* % total solids - % pigment 100 - % pigment		
** excluding water		

**971-19.3 Glass Spheres:** The glass spheres shall meet the requirements of 971-14.

**971-19.4 Sharp Silica Sand:** Sharp silica sand used for bike lane symbols and longitudinal lines shall meet the following gradation requirements:

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

**971-19.5 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 77°F [25°C]	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	-

**971-19.5.1 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.

**971-19.5.2 Color:**

Property	White	Yellow	Black
RD* (Fed Std 141a)	minimum 87%	minimum 43%	-
Color, Visual Match (Fed Std 595a)	Color No. 37875	Color No. 33538	Color No. 37038

\*After four hour ambient dry and 24 hour oven dry at 150°F [66°C].

The color of the yellow traffic paint shall meet the following criteria:

Initial reflectance ..... 43% minimum

Initial chromaticity of the cured yellow traffic paint shall fall within the area bordered by the following coordinates:

X	0.455	0.510	0.472	0.530
Y	0.444	0.485	0.400	0.456

The retained color of the yellow chromaticity coordinates, shall fall within the following limits:

Chromaticity Coordinates (x,y)\*\*:

X	0.435	0.51	0.449	0.53
Y	0.429	0.485	0.377	0.456

\*\*Chromaticity shall fall in an area bordered by these coordinates of a beaded yellow line (for the life of the reflectivity performance when measured in accordance with Florida Test Method FM5-541) when measured with a BYK Gardner Catalog No. 9200 Handy-Color Colorimeter or approved equal by the State Materials Office in accordance with Florida Test Method FM 5-541.

**971-19.5.3 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 220°F [105°C] 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.

**971-19.6 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.

### 971-20 Thermoplastic Material - Hot Spray.

**971-20.1 General:** This work shall consist of furnishing and applying thermoplastic material when the project requires refurbishing existing thermoplastic stripes. The requirements delineated in this Specification, Section 711, and FM 5-541 shall apply.

#### 971-20.2 Composition:

Component	White	Yellow
Binder	25.0% minimum	25.0% minimum
TiO <sub>2</sub> (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

**971-20.3 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.

**971-20.4 Physical Requirements:** Sample specimens shall be prepared in accordance with ASTM D 4960, 8. Procedure shall meet the following requirements:

(a) Color: The white thermoplastic material shall be pure white and free from any tint. Using a colorimeter, such as a Gardner Color Difference Meter, the material shall not show deviations from magnesium oxide color standard greater than the following:

Scale Definition	Magnesium Oxide Standard	Sample
RD	100	75% minimum
Reflectance		
a. Red-Green	0	-5 to +5
b. Yellow-Blue	0	-10 to +10

The initial color of the yellow thermoplastic material shall fall within the following limits:

Reflectance ..... 43% minimum  
 Chromaticity Coordinates (x,y)\*:

X	0.455	0.51	0.472	0.53
Y	0.444	0.485	0.4	0.456

\*Chromaticity shall fall in an area bordered by these coordinates for an initial beaded yellow line when measured with a BYK Gardner Catalog No. 9200 Handy-Color Colorimeter or approved equal by the State Materials Office.

The retained color of the yellow thermoplastic line chromaticity coordinates, shall fall within the following limits:

Chromaticity Coordinates (x,y)\*\*

X	0.435	0.51	0.449	0.53
Y	0.429	0.485	0.377	0.456

\*\*Chromaticity shall fall in an area bordered by these coordinates of beaded yellow line (for the life of the reflectivity performance when measured in accordance with Florida Test Method FM 5-541) when measured with a BYK Gardner Catalog No. 9200 Handy-Color Colorimeter or approved equal by the State Materials Office in accordance with Florida Test Method FM 5-541.

(b) Water Absorption: When tested in accordance with ASTM D 570, the thermoplastic material shall contain no more than 0.5% by weight of retained water.

(c) Softening Point: When tested in accordance with ASTM D 36, the material shall have a softening point of not less than 190°F [90°C].

(d) Low temperature Stress Resistance: A test sample shall not crack or fail to adhere to a concrete substrate when tested in accordance with AASHTO T 250.

(e) Safety: The thermoplastic binder shall not emit fumes which are toxic or otherwise injurious to persons when heated at the manufacturer's recommended application temperature.

(f) Specific Gravity: The specific gravity of the material, measured by water displacement, shall be 1.87 maximum.

(g) 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.

(h) Indentation Resistance: The hardness shall be measured by a Shore Durometer, Type A2, as described in ASTM D 2240. The durometer and the panel shall be at 110°F [45°C] with a 4 lb [2 kg] load applied, the reading shall be between 30 and 5 units after 15 seconds.

(i) Impact Resistance: When tested in accordance with Method A, ASTM D 256, the average impact resistance of four separate samples shall not be less than 10 inch pound [1 N·m].

(j) Flash Point: The thermoplastic material shall have a flash point not less than 475°F [245°C] when tested in accordance with ASTM D 92.

**971-20.5 Glass Spheres:** Glass spheres shall meet the requirements of 971-14.

**971-20.6 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 thickness's shall be measured as specified in Section 711 for refurbishing of thermoplastic stripes.

**971-20.7 Packing and Marking:** The thermoplastic material shall be packed in suitable biodegradable or thermodegradable 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.

## **971-21 Thermoplastic Materials for Raised Rib Shoulder Warning Devices.**

**971-21.1 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, Section 701, and FM 5-541 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.

### **971-21.2 Composition:**

Component	Test Method	White	Yellow
Binder		18.0% minimum	18.0% minimum
TiO <sub>2</sub> , 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)		32.0% maximum	39.5% maximum

Percentages are by weight.

**971-21.3 Glass Spheres:** Glass spheres shall meet the requirements of 971-14.

**971-21.4 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	212°F [100°C]	-
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	475°F [245°C]	-

\*The durometer and panel shall be at least 77°F [25°C], but not exceeding 86°F [30°C] and a 4.4 lb [2 kg] load applied. After 15 seconds, the reading shall not be less than 65 units.

**971-21.4.1 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.

**971-21.4.2 Color:** The white thermoplastic material shall be pure white and free from any tint. Using a Hunter tristimulus colorimeter or approved equivalent in accordance with ASTM D 4960, the material shall not show deviations from magnesium oxide color standard greater than the following:

Scale Definition	Magnesium Oxide Standard	Sample
RD	100.0%	75.0% minimum
Reflectance		
a. Red-Green	0	-5 to +5
b. Yellow-Blue	0	-10 to +10

The color of the yellow thermoplastic material shall meet the following criteria:

Initial reflectance ..... 43% minimum

Initial chromaticity shall fall within the area bordered by the following

coordinates:

X	0.455	0.510	0.472	0.530
Y	0.444	0.485	0.400	0.456

The retained color of the yellow chromaticity coordinates, shall fall within the following limits:

Chromaticity Coordinates (x,y)\*\*:

X	0.435	0.51	0.449	0.53
Y	0.429	0.485	0.377	0.456

\*\*Chromaticity shall fall in an area bordered by these coordinates of a beaded yellow line (for the life of the Reflectivity performance when measured in accordance with Florida Test Method FM 5-541) when measured with a BYK Gardner Catalog No. 9200 Handy-Color Colorimeter or approved equal by the State Materials Office in accordance with Florida Test Method FM 5-541.

**971-21.5 Application Properties:** Application properties shall meet the requirements of Section 701.

**971-21.6 Packing and Labeling:** The thermoplastic material shall be packaged in suitable biodegradable or thermodegradable 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.

## **971-22 Class 5 Applied Finish Coatings for Concrete.**

**971-22.1 General:** Use a commercial product designed specifically for this purpose, which upon curing is capable of accommodating the thermal and elastic expansion ranges of the substrate without cracking.

**971-22.2 Material Tests and Certification:** Meet the requirements of the tests listed below:

(a) Freeze-Thaw Tests: Subject the applied finish coating to Freeze-Thaw Cycle Tests as follows:

(1) Cast and cure three concrete specimens, not less than 4 by 6 by 6 inches [102 by 152 by 152 mm], of the mix design for the structure. Moist cure the specimens for 14 days followed by a drying period in room air at 60 to 80°F [16 to 27°C] for 24 hours.

Ensure that there is no excessive oil on specimen forms. Apply the finish coating to the sides of specimens (brush permitted) at a spreading rate of  $50 \pm 10$  ft<sup>2</sup>/gal [ $1.25 \pm 0.25$  m<sup>2</sup>/L]. Cure the specimens at room temperature and 50% relative humidity for 24 hours, at room temperature and 90% relative humidity for 48 hours, and at room temperature and 50% relative humidity for four days for a total cure time of seven days. After the completion of curing:

(2) Immerse the specimens in water at room temperature (60 to 80°F [16 to 27°C]) for three hours; remove and:

(3) Place in cold storage at -15°F [-26°C] for one hour; remove and;

(4) Thaw at room temperature for one hour.

(5) Repeat Steps three and four for a total of 50 cycles. At the end of 50 cycles Freeze-Thaw Test, verify that the specimens show no visible defects.

(b) Accelerated Weathering: Subject the applied finish coating specimens to a 5,000-hour exposure test in Twin-Carbon-Arc-Weather-ometer, ASTM G 23, Type D, at an operating temperature of 145°F [63°C]. Perform this test at 20-minute cycles consisting of 17 minutes of light and three minutes of water spray plus light. At the end of the exposure test, verify that the exposed samples show no chipping, flaking, or peeling. Prepare the panels for this test by applying the coating at a spreading rate of  $50 \pm 10$  ft<sup>2</sup>/gal [ $1.25 \pm 0.25$  m<sup>2</sup>/L] to both sides and edges of panels cut from non asbestos cement shingles conforming to Federal Specification SS-S-346, Type I. Use curing time as in (a) above.

(c) Fungus Growth Resistance: Ensure that the applied finish coating to be used passes a fungus resistance test as described by Federal Specification TT-P-29G with a minimum incubation period of 21 days where no growth is indicated after the test.

(d) Abrasion Resistance: Ensure that the applied finish coating to be used passes the 3,000 L sand abrasion test, Federal Test Method Standard 141A Method 6191 Abrasion Resistance - Falling Sand.

Prepare the specimens for this test by applying the coating to a cleaned steel panel at a spreading rate of  $50 \pm 10$  ft<sup>2</sup>/gal [ $1.25 \pm 0.25$  m<sup>2</sup>/L]. Cure at room temperature for 21 days.

(e) Impact Resistance: Apply the coating to a concrete panel prepared in accordance with Federal Test Method Standard 141A, Method 2051 at a spreading rate of  $50 \pm 10$  ft<sup>2</sup>/gal [ $1.25 \pm 0.25$  m<sup>2</sup>/L], and allow it to cure for 21 days at room temperature. Then, run the test using the Gardner Mandrel Impact Tester and its method, applying an impact load of 24 inch-pounds [2.7 N·m]. Verify that the coating shows no chipping under this impact load.

(f) Salt-Spray Resistance Test: Coat a concrete specimen with the applied finish coating at a rate of  $50$  ft<sup>2</sup>/gal  $\pm 10\%$  [ $1.25$  m<sup>2</sup>/L  $\pm 10\%$ ], and cure it for 21 days at room temperature.

Using the ASTM B 117 test method, expose the coated specimen to a 5% salt solution for 300 hours where the atmospheric temperature is maintained at  $90 \pm 2^\circ\text{F}$  [ $32 \pm 1^\circ\text{C}$ ]. At the end of 300 hours of exposure, verify that the coating shows no loss of adhesion or deterioration.

(g) Flexibility Test: Coat a sheet metal specimen with the applied finish coating at a rate of  $50 \pm 10 \text{ ft}^2/\text{gal}$  [ $1.25 \pm 0.25 \text{ m}^2/\text{L}$ ]. Bend the coated specimen 180 degrees over a 1 inch [25 mm] round mandrel. After bending, verify that the coating shows no breaking.

Supply a service record showing that the finish coating material has a satisfactory service record for a period of not less than five years prior to the date of submission of the service record and that the finish coating has shown satisfactory service characteristics without peeling, chipping, flaking, or nonuniform change in texture or color. Name a specific structure for the specific product for the service record.

Submit the following product analysis data:

- (a) Weight per gallon [liter].
- (b) Viscosity [Consistency] (Krebs Units).
- (c) Weight percent pigment.
- (d) Weight percent vehicle solids.
- (e) Infra-red spectra of vehicle solution.

**971-22.3 Color:** Use a color that is similar to Federal Color Standard No. 595B, Table VIII, Shade No. 36622 or as specified in the plans for the applied finish coating.

**971-23 Materials for Inverted Profile, Wet Weather Traffic Stripes.**

**971-23.1 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 have the option of formulating the material according to his own specifications. However, the requirements delineated in this Specification, Section 702, and Florida Test Method FM 5-541 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.

**971-23.2 Composition:**

Component	Test Method	White	Yellow
Binder		19.0% minimum	19.0% minimum
TiO <sub>2</sub> , 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)		31.0% maximum	41.0% 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.

**971-23.3 Glass Spheres:** Meet the requirements of 971-14.

**971-23.4 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	200°F [93°C]	-
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	475°F [245°C]	-
*The durometer and panel shall be at 90°F [32°C] with a 4.4 lb [2.0 kg] load applied. Instrument measurement shall be taken after 15 seconds.			

**971-23.4.1 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.

**971-23.4.2 Color:** Meet the requirements of 971-17.5.2.

**971-23.5 Application Properties:** Application properties shall meet the requirements of Section 702.

**971-23.6 Packing and Labeling:** Meet the requirements of 971-17.7.