

**ORIGINATION FORM**  
**Proposed Revisions to the Specifications**

**Date:** 1/9/15

**Specification Section:** 971

**Originator:** Gevin McDaniel

**Articles/Subarticles:**

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**Why does the existing language need to be changed?**

Specifications revisions are required for consistency of new requirements being implemented in the Design Standards and Plans Preparation Manual

**Summary of the changes:**

Revisions to terminology, reorganization, clarifications, and other updates.

**Are these changes applicable to all Department jobs?** Yes  No   
**If not, what are the restrictions?**

**Will these changes result in an increase or decrease in project costs?** Yes  No   
**If yes, what is the estimated change in costs?**

**With who have you discussed these changes?**

Stefanie Maxwell, Paul Gentry, Karen Byram, Melissa Hollis, Trey Tillander, Chester Henson, Tim Lattner

**What other offices will be impacted by these changes?**

Design, Construction, Materials, Estimates and Maintenance

**Will this revision necessitate changes to the following:** BOE  PPM  SDG  CPAM

**Design Standards**  **List Affected Index Nos.** 17346, New Index 519

**Other manual?**

**Are all references to external publications current?** Yes  No   
**If not, what references need to be updated (please include changes in the redline)?**

**Will this revision necessitate any of the following:**

**Design Bulletin**  **Construction Bulletin**  **Estimates Bulletin**

Contact the State Specifications Office for assistance in completing this form.

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**ORIGINATION FORM**  
**Proposed Revisions to the Specifications**

**Date:** 11/26/14

**Specification Section:** 710 and 971

**Originator:** Paul Gentry

**Articles/Subarticles:**

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**Why does the existing language need to be changed?**

Upgrade the language to move the specification from a Developmental 710 and 971 to an implemented Specification 710 and 971 for Durable High Build Paint

**Summary of the changes:**

Modify some of the existing language in both 710 and 971 to be able to make this a implemented specification. The 4 manufacturers have completed the 18 month outdoor weathering test required by the specifications.

**Are these changes applicable to all Department jobs?** Yes  No   
**If not, what are the restrictions?**

**Will these changes result in an increase or decrease in project costs?** Yes  No   
**If yes, what is the estimated change in costs?**

**With who have you discussed these changes?**

Chester Henson, Stefanie Maxwell, Clifton Harper, Karen Byram, Trey Tillander

**What other offices will be impacted by these changes?**

none

**Will this revision necessitate changes to the following:** BOE  PPM  SDG  CPAM

**Design Standards**  **List Affected Index Nos.**

**Other manual?**

**Are all references to external publications current?** Yes  No   
**If not, what references need to be updated (please include changes in the redline)?**

**Will this revision necessitate any of the following:**

**Design Bulletin**  **Construction Bulletin**  **Estimates Bulletin**

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## *Florida Department of Transportation*

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GOVERNOR

605 Suwannee Street  
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JIM BOXOLD  
SECRETARY

### MEMORANDUM

**DATE:** January 9, 2015

**TO:** Specification Review Distribution List

**FROM:** Daniel Scheer, P.E., State Specifications Engineer

**SUBJECT:** Proposed Specification: **9710000 Traffic Marking Materials.**

In accordance with Specification Development Procedures, we are sending you a copy of a proposed specification change.

This change was proposed by Paul Gentry of the Department's Product Evaluation Office to incorporate language from Developmental Specification 971 to the Standard Specifications. The required 18 month weathering test has been successfully completed. Changes were also proposed by Gevin McDaniel of the State Roadway Design Office to revise the language for consistency with new requirements being implemented in the Design Standards and Plans Preparation Manual.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or online at <http://www2.dot.state.fl.us/SpecificationsEstimates/Development/IndustryReview.aspx> . Comments received after **February 6, 2015**, may not be considered. Your input is encouraged.

DS/dt  
Attachment

## TRAFFIC MARKING MATERIALS.

(REV ~~12-17-14~~*1-9-15*)

### SECTION 971 ~~TRAFFIC~~*PAVEMENT* MARKING MATERIALS

#### 971-1 General Requirements.

**971-1.1 Packaging and Labeling:** ~~All traffic pavement marking materials shall be shipped in strong containers plainly marked with the weight in pounds per gallon, the volume of traffic pavement marking materials content in gallons, the color, user information, date of manufacture, 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 on the label.* The label shall warn the user of any special handling or precautions of the material, as recommended by the manufacturer. Any packaging *and labeling* 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 batch number.~~

**971-1.2 Storage:** *All materials must have a container storage life of one year from date of manufacture.* Any ~~traffic pavement~~ 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 pavement 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 Thinners~~ shall not be used ~~for thinner~~ under any circumstances.

**971-1.4 Approved Product List (APL):** All ~~traffic pavement~~ marking materials shall be one of the products listed on the Department's Approved Product List (APL). 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  $\mu\text{m}$ ) for the vehicle component. *The Department will test all pavement marking materials in accordance with FM5-541, Part B.* ~~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 APL. When listed, this will be the minimum criteria for application of the ~~traffic pavement~~ marking material.

**971-1.5 Samples:** Field samples will be obtained in accordance with the Department's Sampling, Testing and Reporting Guide Schedule.

**971-1.6 Color:** Materials other than *white and* yellow shall meet the color requirements as identified in 23 CFR 665 Table 5 Appendix to Part- 655, Subpart F. ~~White colored materials will only be required to meet the initial daytime chromaticity requirements.~~

Yellow materials for pavement markings shall meet the following performance requirements.

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

~~Initial Daytime Chromaticity Coordinates (Corner Points)~~

<i>Initial Daytime Chromaticity Coordinates (Corner Points)</i>				
	1	2	3	4
X	0.530	0.510	0.455	0.472
Y	0.456	0.485	0.444	0.400

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

~~Nighttime Chromaticity Coordinates (Corner Points)~~

<i>Nighttime Chromaticity Coordinates (Corner Points)</i>				
	1	2	3	4
X	0.575	0.508	0.473	0.510
Y	0.425	0.415	0.453	0.490

**971-1.7 Additional Requirements:** ~~Traffic~~*Pavement* marking materials shall be characterized as non-hazardous as defined by Resource Conservation and Recovery Act (RCRA) 40 CFR 261. Provide supporting independent analytical data or product material safety data sheets (MSDS) identifying any components listed in Table 1 of 40 CFR 261.24.

Additionally, retroreflective elements shall contain no more than 200 ppm by weight of lead or arsenic when tested in accordance with the Environmental Protection Agency (EPA) Testing Methods 3052, 6010B, and 6010C.

**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.

**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
Roundness*	ASTM D1155	Min: 70 % by weight
Roundness**	ASTM D1155	Min: 80% by weight
Refractive Index*	Becke Line Method (25+/-5C)	1.5 minimum
Refractive Index**	Becke Line Method (25+/-5C)	1.9 minimum
*Type 1, 3, 4 and 5 beads		
**High Index beads		

Sieve Size	Percent by Mass Passing Designated Sieve (ASTM D1214)
	Grading Designation

	Type 1 (AASHTO)	Type 3 (FP 96)	Type 4 (FP 96)	Type 5 (FP 96)	High Index
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	100	80 - 95	10 - 40	0 - 5	100
No. 18		10 - 40	0 - 5	0 - 2	
No. 20	95 - 100	0 - 5	0 - 2		95 - 100
No. 25		0 - 2			
No. 30	75 - 95				55 - 85
No. 40					15 - 45
No. 50	15 - 35				0 - 5
No. 80					
No. 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 pound sample of glass spheres shall be obtained for each 50,000 pound shipped. *Send each 50 pound sample to the State Materials Office.* ~~Upon arrival, the quantity of material will be reduced in a sample splitter to a size of approximately one quart by the Engineer, or one 50 pound unopened bag.~~

~~971-2.3.2 Containers:~~ The spheres shall be furnished in new 50 pound moisture-proof bags. All containers shall meet *Interstate Commerce Commission* requirements for strength and type and be marked in accordance with AASHTO 247 Part 5.

**971-3 Standard Waterborne Fast Dry Traffic Paint.**

~~971-3.1 General:~~ Standard ~~waterborne 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 paint shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic.~~ The ~~material~~ paint 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~~ paint 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~~ paint shall be free from all skins, dirt and foreign objects.

**971-3.2 Composition:**

Component	Test Method	Criteria
Total Solids, by weight	ASTM D2369	minimum 75%
Pigments, by weight	ASTM D3723	minimum 57%
Vehicle Solids % of Vehicle*		minimum 40%
TiO <sub>2</sub> , Type II Rutile (white paint only)	ASTM D476	minimum 1.0 lb/gal
Volatile Organic Content, (VOC)	ASTM D3960	maximum 150 g/L

\*Vehicle Solids % of Vehicle =  $\frac{\% \text{ total solids} - \% \text{ pigment}}{100 - \% \text{ pigment}}$

**971-3.3 Physical Requirements:** ~~The material shall meet the following criteria:~~ *Test laboratory samples in accordance with ASTM D4960 and also meet the following criteria:*

Property	Test Method	Minimum	Maximum
Density	ASTM D1475	13.5 ± 1.4 lb/gal	-
Viscosity at 77°F	ASTM D562	80 KU	100 KU
Fineness of Grind	ASTM D1210	3(HS)	
Dry Opacity at 5 mils WFT	ASTM D2805	0.92	-
Bleed Ratio	ASTM D969	0.95	-
Flexibility	ASTM D522 Method B	Pass	-
Abrasion Resistance	ASTM D4060	Pass	-

**971-3.3.1 Set To Bear Traffic Time:** The ~~material~~*paint* shall set to bear traffic in not more than two minutes.

**971-3.3.2 Abrasion Resistance:** Test four samples using a Taber Abrader. The paint shall be applied to specimen plates using a drawdown blade having a clearance of 20 mils. Clean with a soft brush and weigh each sample. Abrade samples for 1,000 cycles with a combined load of 500 g (arm plus auxiliary weight) on each arm 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 75 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<sup>2</sup> and 250 mcd/lx·m<sup>2</sup>, *respectively*. The retroreflectance of the white and yellow pavement markings at the end of the six month ~~service life period~~ shall not be less than 150 mcd/lx·m<sup>2</sup>.

**971-3.4 Application Properties:** *Meet the requirements of Section 710 for application properties.*

**971-3.45 Packaging and Labeling:** The ~~traffic~~ paint shall be placed in 55 gallon open-end steel drums with a re-usable multi-seal sponge gasket. No more than 50 gallons of ~~material~~*paint* shall be placed in any drum to allow for expansion during transport and storage. *Clearly mark the containers with the weight in pounds per gallon, the volume of materials in units of gallons, the color, date of manufacture, batch number, and APL number.*

#### **971-4 Durable High Build Paint.**

**971-4.1 General:** *Durable* ~~igh build~~ paints ~~intended for use under this Specification~~ shall include *water reducible* products that are single packaged and ready mixed. ~~Upon curing, these~~

~~materials~~ paint shall produce an adherent, reflective pavement marking capable of resisting deformation by traffic. *The paint 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~~ paint shall be free from all skins, dirt and foreign objects. *The manufacturer shall provide the recommended thickness prior to installation.*

**971-4.2 Composition:**

Component	Test Method	Criteria
Total Solids, by weight	ASTM D2369	75% minimum
Pigments, by weight	ASTM D3723	57% minimum
Vehicle Solids, % on Vehicle*		40% minimum
TiO <sub>2</sub> , Type II Rutile (white paint only)	ASTM D476	1.50 lb/gal minimum
Volatile Organic Content, (VOC)	ASTM D3960	150 g/L maximum
*Vehicle Solids % of Vehicle = $\frac{\% \text{ total solids} - \% \text{ pigment}}{100 - \% \text{ pigment}}$ <i>Vehicle solids shall be 100% acrylic emulsion polymer.</i>		

**971-4.3 Physical Requirements:** *Test laboratory samples in accordance with ASTM D4960 and also meet the following criteria:* ~~The material shall meet the following criteria:~~

Property	Test Method	Minimum	Maximum
Density	ASTM D1475	13.5 ± <del>0.37</del> 1.4 lb/gal	N/A
Viscosity at 77°F	ASTM D562	80 KU	100 KU
Fineness of Grind	ASTM D1210	3(HS)	
Dry Opacity at 5 mils WFT	ASTM D2805	0.92	-
Bleed Ratio	ASTM D969	0.95	-
Flexibility	ASTM D522 Method B	Pass	-
Abrasion Resistance	ASTM D4060	Pass	-
*Vehicle Solids % of Vehicle = $\frac{\% \text{ total solids} - \% \text{ pigment}}{100 - \% \text{ pigment}}$			

**971-4.3.1 Set To Bear Traffic Time:** The ~~material~~ paint shall set to bear traffic in not more than ~~two~~ten minutes.

**971-4.3.2 Abrasion Resistance:** Test four samples using a Taber Abrader. The paint shall be applied to specimen plates using a drawdown blade having a clearance of 20 mils. *Air dry each sample until fully cured based on the manufacturers product recommendation.* Clean with a soft brush and weigh each sample. Abrade samples for 1,000 cycles with a combined load of 500 g (arm plus auxiliary weight) on each arm 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 75 mg per plate.

**971-4.3.3 Retroreflectivity:** The white and yellow pavement markings shall attain an initial retroreflectance of not less than ~~300~~**450** mcd/lx·m<sup>2</sup> and ~~250~~**300** mcd/lx·m<sup>2</sup>, respectively. The retroreflectance of the white and yellow pavement markings at the end of the ~~six~~**18** month ~~service life~~**period** shall not be less than 150 mcd/lx·m<sup>2</sup>.

**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 gallon open-end steel drums with a re-usable multi-seal sponge gasket. No more than 50 gallons of ~~material~~ paint shall be placed in any drum to allow for expansion during transport and storage. *Clearly mark the containers with the weight in pounds per gallon, the volume of materials in units of gallons, the color, date of manufacture, batch number and APL number.*

**971-5 Standard 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 <sub>2</sub> , Type II Rutile	ASTM D476	10.0% minimum	-
Glass Spheres	AASHTO T250	40.0% minimum	40.0% minimum
Yellow Pigment		-	% minimum per manufacturer
Calcium Carbonate and Inert Filler (-200 mesh 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 *and meeting the requirements of this Section.* ~~Glass spheres shall meet the requirements of 971-2.~~

**971-5.4 Sharp Silica Sand:** Sharp silica sand used for *bicycle markings* ~~ke lane symbols~~ and pedestrian crosswalk lines shall meet the following gradation requirements:

Sieve Size	% Passing
20	100
50	0 to 10

**971-5.5 Physical Requirements:** Laboratory samples shall be ~~prepared~~*tested* in accordance with ASTM D4960 and shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Water Absorption	ASTM D570	-	0.5%
Softening Point	ASTM D36	195°F	-
Low Temperature Stress Resistance	AASHTO T250	Pass	-
Specific Gravity	Water displacement	1.9	2.3
Indentation Resistance	ASTM D7735* Type A Durometer	40	75
Impact Resistance	ASTM D256, Method A	1.0 N·m	-
Flash Point	ASTM D92	475°F	-

\* The durometer and panel shall be at 115°F with a 1000 g load applied. Instrument measurement shall be taken after 15 seconds.

**971-5.5.1 Set To Bear Traffic Time:** 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<sup>2</sup> and not less than 350 mcd/lx·m<sup>2</sup>, respectively. The retroreflectance of the white and yellow pavement markings at the end of the three year ~~service life period~~ shall not be less than ~~150-300~~ mcd/lx·m<sup>2</sup>.

**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~~*pounds*. The label shall warn the user that the material shall be heated in the range as recommended by the manufacturer.

#### **971-6 Preformed Thermoplastic Materials ~~for Traffic Stripes.~~**

**971-6.1 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.~~

**971-6.2 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.

**971-6.3 Glass Spheres:** Material shall contain no less than 30% glass spheres by weight.

**971-6.4 Color:** Materials shall meet the performance requirements specified in ~~971-1~~*this Section* and the following additional requirements. The initial luminance factor, Cap Y, shall not be less than 55.

**971-6.5 Physical Requirements:** Laboratory samples shall be ~~prepared~~*tested* in accordance with ASTM D4960 and shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Softening Point	ASTM D36	195°F	-
Low Temperature Stress Resistance	AASHTO T250	Pass	-
Indentation Resistance	ASTM D7735* Type A Durometer	40	75
Impact Resistance	ASTM D256, Method A**	1.0 N·m	-

\*The durometer and panel shall be at 115°F with a 1000 g load applied. Instrument measurement shall be taken after 15 seconds.  
\*\*The test specimen for ASTM D256 shall be 1 in. x 1 in. x 6 in. and shall not be notched.

**971-6.5.1 Retroreflectivity:** The white and yellow pavement markings shall attain an initial retroreflectance of not less than 300 mcd/lx·m<sup>2</sup>. *All pedestrian crosswalks and; bicycle markings*~~ke lane symbols and messages in a proposed bike lane shall attain initial retroreflectivity of not less than 275 mcd/lx·m<sup>2</sup>.~~ The retroreflectance of the white pavement markings at the end of the three year *service life period* shall not be less than 150 mcd/lx·m<sup>2</sup>. ~~All pedestrian crosswalks, bike lane symbols and messages in a proposed bike lane shall attain initial retroreflectivity of not less than 275 med/lx·m<sup>2</sup>.~~

**971-6.5.2 Skid Resistance:** The surface of the ~~stripes and~~ *pavement* markings shall provide a minimum skid resistance value of 35 BPN (British Pendulum Number) when tested according to ASTM E303. *Bicycle markings*~~ke lane symbols~~ and pedestrian crosswalks shall provide a minimum skid resistance value of 55 BPN.

**971-6.6 Application Properties:** Application properties shall meet the requirements of Section 711.

**971-6.7 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. *Clearly mark each container with the thickness of the preformed material in units of inches, the color, date of manufacture, batch number and APL number.*

#### **971-7 Permanent Tape Materials** ~~for Traffic Stripes and Markings.~~

**971-7.1 General:** The materials for *permanent tape* 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 and Section 713 shall apply. ~~The material shall be free from all skins, dirt and foreign objects.~~

**971-7.2 Composition:** ~~The~~ *Permanent tape* 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.

**971-7.3 Skid Resistance:** The surface of the ~~stripes and~~ *pavement* markings shall provide a minimum skid resistance value of 35 BPN when tested according to ASTM E303. *Bicycle markings*~~ke lane symbols~~ and pedestrian crosswalks shall provide a minimum skid resistance value of 55 BPN.

**971-7.4 Thickness:** The APL will list the specified thickness of each approved product.

**971-7.5 Durability and Wear Resistance:** ~~When properly applied, the material shall provide neat, durable stripes and pavement 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

*as defined in, and in accordance with, FM5-541, Part B.*

**971-7.6 Conformability and Resealing:** The ~~stripes and pavement~~ 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.

**971-7.7 Tensile Strength:** The ~~stripes and pavement~~ markings shall have a minimum tensile strength of 40 psi when tested according to ASTM D638. A rectangular test specimen 6 inches by 1 inch by 0.05 inches minimum thickness shall be tested at a temperature range of 40 to 80°F using a jaw speed of 0.25 inch/min.

~~**971-7.8 Plastic Pull test:** The stripes and pavement markings shall support a dead weight of 4 lbpounds for not less than five minutes at a temperature range of 70 to 80°F. Rectangular test specimen size shall be 6 inches by 1 inch by 0.05 inches minimum thickness.~~

**971-7.89 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 pavement~~ markings. *Test laboratory samples in accordance with ASTM D4960.*

**971-7.910 Glass Spheres:** The ~~stripes and pavement~~ markings shall have glass retention qualities such that, when at room temperature a 2 inches by 6 inches specimen is bent over a 0.5 inch 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.

**971-7.101 Retroreflectivity:** ~~The permanent tape materials for traffic stripes and pavement markings shall have a service life of five years.~~ The materials shall attain an initial retroreflectance of not less than 450 mcd/lx·m<sup>2</sup> for white ~~and contrast~~ markings and not less than 350 mcd/lx·m<sup>2</sup> for yellow markings. The pavement ~~stripes and~~ markings shall retain a minimum retroreflectance for two years of not less than 300 mcd/lx·m<sup>2</sup> for white ~~and contrast~~ markings and not less than 250 mcd/lx·m<sup>2</sup> for yellow markings. The retroreflectance of the white, yellow and contrast pavement markings at the end of the five year ~~service life~~ *period* shall not be less than 150 mcd/lx·m<sup>2</sup>.

**971-7.11 Packaging and Labeling:** *Ship all permanent tape materials in containers which will not adhere to the product during shipment and storage. Clearly mark each container with the thickness of the preformed material in units of inches, the color, date of manufacture, batch number and APL number.*

## **971-8 Two Reactive Component Materials ~~For Traffic Stripes And Markings.~~**

**971-8.1 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. The material shall be free from all skins, dirt and foreign objects.

### **971-8.2 Composition:**

Component	Test Method	Criteria
TiO <sub>2</sub> , Type II Rutile (white material only)	ASTM D476	minimum 10% by weight
Volatile Organic Content, (VOC)	ASTM D3960	maximum 150 g/L

**971-8.3 Physical Requirements:** *Test laboratory samples in accordance with ASTM D4960 and also meet the following criteria:* ~~The material shall meet the following criteria:~~

Property	Test Method	Minimum	Maximum
Adhesion to Concrete	ASTM D4541, ASTM D7234 or ACI 503	Concrete Failure	-
Hardness	ASTM D7735 Type D	75	-
Abrasion Resistance	ASTM D4060	Pass	-

**971-8.3.1 Set To Bear Traffic Time:** The material shall set to bear traffic in not more than two minutes.

**971-8.3.2 Abrasion Resistance:** Test four samples using a Taber Abrader. The material shall be applied to specimen plates using a drawdown blade having a clearance of 15 mils. Clean with a soft brush and weigh each sample. Abrade samples for 1,000 cycles with a combined load of 500 g (arm plus auxiliary weight) on each arm 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 60 mg per plate.

**971-8.3.3 Retroreflectivity:** The white and yellow pavement markings shall attain an initial retroreflectance of not less than 450 mcd/lx·m<sup>2</sup> and not less than 350 mcd/lx·m<sup>2</sup>, respectively. The retroreflectance of the white and yellow pavement markings at the end of the three year *service life period* shall not be less than 150 mcd/lx·m<sup>2</sup>.

**971-8.4 Application Properties:** Application properties shall meet the requirements of Section 709.

**971-8.5 Packaging and Labeling:** The two reactive component material shall be placed in 55 gallon open-end steel drums with a re-usable multi-seal sponge gasket. No more than 50 gallons of material shall be placed in any drum to allow for expansion during transport and storage. *Clearly mark the containers with the weight in pounds per gallon, the volume of materials in units of gallons, the color, generic type (e.g. epoxy), date of manufacture, batch number and APL number.* ~~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.~~

### **971-9 Profiled Thermoplastic Material for Audible and Vibratory Traffic Stripes.**

**971-9.1 General:** ~~Upon cooling to normal pavement temperature, the thermoplastic material 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 shall apply regardless of the type of formulation used. The

pigment, reflective elements, 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 <sub>2</sub> , Type II Rutile	ASTM D476	10.0% minimum	-
Reflective Elements	AASHTO T250	% minimum per manufacturer	% minimum per manufacturer
Yellow Pigment		-	% minimum per manufacturer
Calcium Carbonate and Inert Filler (-200 mesh sieve)		% minimum per manufacturer	% minimum per manufacturer

*Note:* 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.

**971-9.3 Retroreflective Elements:** The reflective elements in the intermix shall be determined by the manufacturer and identified for the APL.

**971-9.4 Physical Requirements:** Laboratory samples shall be ~~prepared~~ *tested* in accordance with ASTM D4960 and shall meet the following criteria:

Property	Test Method	Minimum	Maximum
Water Absorption	ASTM D570	-	0.5%
Softening Point	ASTM D36	210°F	-
Low Temperature Stress Resistance	AASHTO T250	Pass	-
Specific Gravity	Water displacement	1.9	2.3
Indentation Resistance	ASTM D7735* Type A Durometer	65	-
Impact Resistance	ASTM D256, Method A	1.0 N·m	-
Flash Point	ASTM D92	475°F	-

\*The durometer and panel shall be at 80°F, with a 1000 g 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 701, the baseline material shall set to bear traffic in not more than two minutes. The ~~audible~~ bumps shall set to bear traffic in not more than 10 minutes at ambient air temperatures of 80°F or less and in not more than 15 minutes for ambient air temperatures exceeding 80°F.

**971-9.4.2 Retroreflectivity:** The white and yellow pavement markings shall attain an initial retroreflectance of not less than 300 mcd/lx·m<sup>2</sup> and not less than 250 mcd/lx·m<sup>2</sup>, respectively. The retroreflectance of the white and yellow pavement markings at the end of the three year ~~service life~~ *period* shall not be less than 150 mcd/lx·m<sup>2</sup>.

**971-9.4.3 Durability:** Durability shall include flattening of the profile or raised portions of the line. The flattening of the profile or raised portion of the line shall not exceed 25% at the end of the three year ~~service life~~*period*.

**971-9.5 Application Properties:** Application properties shall meet the requirements of Section 701.

**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~~*pounds*. The label shall warn the user that the material shall be heated in the range as recommended by the manufacturer.