Florida Department of Transportation

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February 8, 2010

Monica Gourdine
Program Operations Engineer
Federal Highway Administration
545 John Knox Road, Suite 200
Tallahassee, Florida 32303

Re: Office of Design, Specifications
Section 994
Proposed Specification: **9940000 Retroreflective and Nonreflective Sheeting for Traffic Control Devices**

Dear Ms. Gourdine:

We are **resubmitting**, for your approval, two copies of the above referenced Supplemental Specification.

In 994-3.1, we deleted the requirement for fungal resistance testing. Fungal resistance testing is described in ASTM D-4956, and is only a requirement if specified by the owner. Fungal resistance testing has not been a requirement by the Department.

If you have any questions relating to this specification change, please contact Rudy Powell, State Specifications Engineer at 414-4280 or Email at rudy.powell@dot.state.fl.us.

Sincerely,

Rudy Powell, Jr., P.E.
State Specifications Engineer

RP/dt
Attachment
cc: Gregory Jones, Chief Civil Litigation
Florida Transportation Builders' Assoc.
State Construction Engineer

## *994* RETROREFLECTIVE AND NONREFLECTIVE SHEETING FOR TRAFFIC CONTROL DEVICES.

**(REV *2*~~111098~~-*8*~~16282914~~-*10*09)** ***(FA 11-30-09) (7-10)***

SECTION 994 (PAGES 977 – 980) is deleted and the following substituted:

### SECTION 994
### RETROREFLECTIVE AND NONREFLECTIVE SHEETING FOR TRAFFIC CONTROL DEVICES

**994-1 Description.**

**994-1.1 General:** This Section specifies the requirements for retroreflective and nonreflective sheeting materials, transparent and opaque process inks for retroreflective sheeting materials and film overlays for traffic control devices. ~~The sheeting materials used shall be one of the products included on the Qualified Products List (QPL), as specified in 6-1.~~

**994-1.2 Classification:** Retroreflective sheeting material Types III, IV, V, and VI shall be classified in accordance with ASTM D-4956. In addition, a special classification, Type VII (Special) is added for super high intensity retroreflective sheeting. This special classification shall include materials classified as Type VII*I* and above in accordance with ASTM D-4956. ~~A special classification for Type VI fluorescent pink is also added.~~

***994-1.3*~~2~~ Qualified Products List:** *All sheeting, process inks and film overlay materials shall be listed on the Qualified Products List (QPL). Manufacturers seeking evaluation of their products shall submit product data sheets, performance test reports from an independent laboratory showing the product meets the requirements of this section, and a QPL application in accordance with Section 6. Information on the QPL application must include the product colors included in the application, classification, adhesive backing class, and liner type. Information on the QPL application for process inks and film overlay products must also include the compatible reflective sheeting material.*

**994-2 Materials.**

~~Retroreflective sheeting, screen processing inks and film overlay materials used for any of the applications described herein shall be one of the products included on the QPL, as specified in 6-1. The retroreflective s~~*S*heeting shall meet the requirements of Types III, IV, V, VI in ASTM D-4956 or Type VII (Special) and fluorescent pink listed below in accordance with their approved usage. ~~Samples shall be taken in accordance with the Department's Sampling, Testing and Reporting Guide Schedule and on a random basis at the discretion of the Engineer.~~

**994-3 Performance Requirements.**

**994-3.1 ~~Testing~~General:** ~~The retroreflective s~~*S*heeting~~.~~*, process inks and film overlay materials* shall be tested in accordance with*, and meet all the performance requirements of* ASTM D-4956*, including Supplemental Requirement S2, Reboundable Sheeting Requirements, except as amended in this Section.* ~~and the Florida Test Method for retroreflective and nonreflective sheeting, FM 5-571. For retroreflectivity, the~~

~~sheeting materials shall meet the minimum requirements as stated for 0.2 degree and 0.5 degree observation angles in ASTM D-4956. Evaluation of test samples shall be field tested in accordance with FM 5-571 for each color~~ *Classification Type VII (Special) shall be tested in accordance with, and meet the performance requirements of ASTM D-4956 Type VIII, except as amended in this Section. For performance requirements that are color dependant, each color included in the QPL application must be tested and meet the requirements identified in ASTM D-4956 or this Section as applicable. Process inks and film overlay materials shall be applied to reflective sheeting in accordance with Section 994-4 for testing.* ~~*Fungal resistance testing is not required.*~~

~~*Classification Type VII (Special) shall be tested in accordance with, and meet the performance requirements of ASTM D-4956 Type VII, except as amended in this Section. For performance requirements that are color dependant, each color included in the QPL application must be tested and meet the requirements identified in ASTM D-4956 or this Section as applicable. Process inks and film overlay materials shall be applied to reflective sheeting in accordance with Section 994-4 for testing. Fungal resistance testing is not requ.*~~

**994-3.2 Retroreflective Intensity:** The retroreflective sheeting shall meet the minimum initial requirements as stated for 0.2 degree and 0.5 degree observation angles in ASTM D-4956. Type VI fluorescent pink sheeting and Type VII (Special) sheeting shall meet the minimum retroreflectivity requirements listed below.

| *Type VII (Special) Sheeting* | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Minimum Coefficient of Retroreflection (cd/foot-candle·ft$^2$)(cd/fc·ft$^2$)* | | | | | | | | | | |
| *Observation/Entrance Angle (degree)* | *White* | *Yellow* | *Red* | *Orange* | *Blue* | *Green* | *Brown* | *Fluorescent Orange* | *Fluorescent Yellow* | *Fluorescent Yellow/Green* |
| *0.2/-4* | *380* | *304* | *95* | *250* | *19* | *38* | *19* | *180* | *220* | *360* |
| *0.5/-4* | *250* | *195* | *55* | *100* | *12* | *25* | *8* | *60* | *145* | *235* |
| *0.2/30* | *220* | *176* | *48* | *110* | *11* | *22* | *9* | *85* | *125* | *205* |
| *0.5/30* | *135* | *105* | *30* | *50* | *7* | *14* | *3* | *33* | *75* | *125* |

| *Type VI Sheeting* | |
|---|---|
| *Minimum Coefficient of Retroreflection (cd/foot-candle·ft$^2$)(cd/fc·ft$^2$)* | |
| *Observation/Entrance Angle (degree)* | *Fluorescent Pink* |
| *0.2/-4* | *160* |
| *0.5/-4* | *100* |
| *0.2/30* | *100* |
| *0.5/30* | *40* |

**994-3.3 Color:** ~~The retroreflective and nonreflective sheeting or film shall conform to both the daytime and nighttime color requirements of ASTM D-4956, In addition to ASTM D-4956, t~~*At failure, no color shall fade into another ASTM D-4956 defined color's x, y chromaticity coordinates.*

*T*he fluorescent pink initial color shall meet the following x, y chromaticity coordinates:

| Fluorescent Pink | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| x | .450 | .590 | .644 | .536 |
| y | .270 | .350 | .290 | .230 |

~~The daytime luminance factor shall meet ASTM D-4596 except for~~ f*F*luorescent pink sheeting ~~which~~ shall have a minimum luminance factor of 25.

~~**994-3.3.1 Accelerated Outdoor Test:** The retroreflective and nonreflective materials shall meet the ASTM D-4956 Accelerated Outdoor Table weathering requirements for performance except Type VI fluorescent pink and fluorescent yellow.~~

***994-3.4 Outdoor Weathering****: Outdoor weathering exposure of sign sheeting materials shall be in accordance with, and meet the requirements of ASTM D-4956 for each product color and classification and conducted at an exposure location meeting the Tropical Summer Rain Climate Type (Miami, Florida or equivalent). Outdoor weathering is not required for Type VI fluorescent pink and fluorescent yellow.*

~~**994-3.4 Adhesive Backing:** The adhesive backing of the retroreflective and nonreflective sheeting or film shall be either Class 1, Class 2 or Class 5 per ASTM D-4956. The retroreflective and nonreflective sheeting or film, after application, shall tightly adhere to the application surface and show no discoloration, cracking, crazing, blistering or dimensional change.~~

~~**994-3.5 Physical Properties:** The retroreflective and nonreflective sheeting or film material shall meet the ASTM D-4956 minimum requirements for colorfastness, shrinkage, flexibility, liner removal, adhesion, impact resistance and specular gloss.~~

~~**994-3.6 Color Processibility:** The retroreflective sheeting shall permit color processing with compatible transparent and opaque process inks as approved by the sheeting manufacturer and listed on the QPL.~~

| ~~Type VII (Special) Sheeting~~<br>~~Minimum Coefficient of Retroreflection~~<br>~~(cd/foot-candle·ft$^2$)(cd/fc·ft$^2$)~~ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ~~Observation/Entrance Angle (degree)~~ | ~~White~~ | ~~Yellow~~ | ~~Red~~ | ~~Orange~~ | ~~Blue~~ | ~~Green~~ | ~~Brown~~ | ~~Fluorescent Orange~~ | ~~Fluorescent Yellow~~ | ~~Fluorsecent Yellow/Green~~ |
| ~~0.2/-4~~ | ~~380~~ | ~~304~~ | ~~95~~ | ~~250~~ | ~~19~~ | ~~38~~ | ~~19~~ | ~~180~~ | ~~220~~ | ~~360~~ |
| ~~0.5/-4~~ | ~~250~~ | ~~195~~ | ~~55~~ | ~~100~~ | ~~12~~ | ~~25~~ | ~~8~~ | ~~60~~ | ~~145~~ | ~~235~~ |
| ~~0.2/30~~ | ~~220~~ | ~~176~~ | ~~48~~ | ~~110~~ | ~~11~~ | ~~22~~ | ~~9~~ | ~~85~~ | ~~125~~ | ~~205~~ |
| ~~0.5/30~~ | ~~135~~ | ~~105~~ | ~~30~~ | ~~50~~ | ~~7~~ | ~~14~~ | ~~3~~ | ~~33~~ | ~~75~~ | ~~125~~ |

| ~~Type VI Sheeting~~<br>~~Minimum Coefficient of Retroreflection~~<br>~~(cd/foot-candle·ft$^2$)(cd/fc·ft$^2$)~~ | |
|---|---|
| ~~Observation/Entrance Angle~~ | ~~Fluorescent Pink~~ |
| ~~(degree)~~ | |
| ~~0.2/-4~~ | ~~160~~ |
| ~~0.5/-4~~ | ~~100~~ |
| ~~0.2/30~~ | ~~100~~ |

| ~~Type VI Sheeting~~ | |
|---|---|
| ~~Minimum Coefficient of Retroreflection~~<br>~~(cd/foot-candle·ft$^2$)(cd/fc·ft$^2$)~~ | |
| ~~Observation/Entrance Angle~~ | ~~Fluorescent Pink~~ |
| ~~(degree)~~ | |
| ~~0.5/30~~ | ~~40~~ |

**994-4 Direct and Reverse Screen Processing.**

**~~994-4.1 General:~~** The transparent and opaque process inks furnished for direct and reverse screen processing shall be of a type and quality formulated for retroreflective sheeting materials as listed on the QPL and applied in accordance with the manufacturer's instruction. Screen processing in accordance with the techniques and procedures recommended by the manufacturer shall produce a uniform legend of continuous stroke width of either transparent or opaque ink, with sharply defined edges and without blemishes on the sign background that will affect the intended sign use. ~~The process inks shall be one of the products listed on the QPL.~~

*The retroreflective sheeting shall permit color processing with compatible transparent and opaque process inks as approved by the sheeting manufacturer and listed on the QPL.*

~~**994-4.2 Color:** The daytime color of the finished transparent process inks shall conform to the requirements as specified in 994-3.3.~~

**994-5 In-Service Minimum Requirements.**

The retroreflective sheeting and screen processed retroreflective sheeting shall have the minimum coefficient of retroreflection as shown in ASTM D-4956, Outdoor Weathering Photometric Requirements for All Climates except Type VI fluorescent pink and fluorescent yellow. In addition, Type VII (Special) classified sheeting materials shall have a minimum coefficient of retroreflection of 80% of the values listed in the above table. Only the observation angle of 0.2 degrees and an entrance angle of -4 degrees shall be used in measuring in-service minimums. The in-service life for opaque overlay films, black processing inks and opaque lettering shall equal the life of the reflective sheeting to which it is applied.

**994-6 Packaging and Labeling.**

~~Shipment shall be made in containers which are acceptable to common carriers and packaged in such a manner as to ensure delivery is in perfect condition. Each package shall be clearly marked as to the name of the manufacturer, series, color, quantity enclosed and date of manufacture.~~*Packaging and labeling shall meet the requirements of ASTM D-4956.*

~~**994-7 Certification.**~~

~~For permanently installed signs, the Contractor shall be required to furnish to the Engineer one material certification from the sheeting manufacturer documenting that the retroreflective sheeting meets the requirements of this Section. Each certification shall cover only one type of retroreflective or non reflective sheeting or film. The certification shall meet the requirements in Section 6.~~

~~Certification shall not be required for signs and devices used in the work zone.~~

~~**994-8 Qualified Products List.**~~

~~**994-8.1 General:** All reflective and nonreflective sheeting materials and process inks shall be one of the products listed on the QPL. Products may only be used for applications recommended by the manufacturer. A notation of the sheeting materials approved for the inks may be placed on the QPL.~~

~~**994-8.2 Other Requirements:** Manufacturers seeking approval of sheeting material products shall submit an application, Material Safety Data Sheet (MSDS), and certification. Non-sheeting materials may be submitted under this Section with reference to specific equivalency of performance requirements of overall end product. Final acceptance will be based on tests and verification in accordance with this Specification, FM 5-571 and 6-1.~~

**994-7~~9~~ Samples.**

Field samples will be obtained in accordance with the Department's Sampling, Testing and Reporting Guide Schedule *or on a random basis at the discretion of the Engineer*.

**994 RETROREFLECTIVE AND NONREFLECTIVE SHEETING FOR TRAFFIC CONTROL DEVICES.**
**(REV 11-16-09) (FA 11-30-09) (7-10)**

SECTION 994 (PAGES 977 – 980) is deleted and the following substituted:

## SECTION 994
## RETROREFLECTIVE AND NONREFLECTIVE SHEETING FOR TRAFFIC CONTROL DEVICES

**994-1 Description.**

**994-1.1 General:** This Section specifies the requirements for retroreflective and nonreflective sheeting materials, transparent and opaque process inks for retroreflective sheeting materials and film overlays for traffic control devices.

**994-1.2 Classification:** Retroreflective sheeting material Types III, IV, V, and VI shall be classified in accordance with ASTM D-4956. In addition, a special classification, Type VII (Special) is added for super high intensity retroreflective sheeting. This special classification shall include materials classified as Type VIII and above in accordance with ASTM D-4956.

**994-1.3 Qualified Products List:** All sheeting, process inks and film overlay materials shall be listed on the Qualified Products List (QPL). Manufacturers seeking evaluation of their products shall submit product data sheets, performance test reports from an independent laboratory showing the product meets the requirements of this section, and a QPL application in accordance with Section 6. Information on the QPL application must include the product colors included in the application, classification, adhesive backing class, and liner type. Information on the QPL application for process inks and film overlay products must also include the compatible reflective sheeting material.

**994-2 Materials.**

Sheeting shall meet the requirements of Types III, IV, V, VI in ASTM D-4956 or Type VII (Special) and fluorescent pink listed below in accordance with their approved usage.

**994-3 Performance Requirements.**

**994-3.1 General:** Sheeting, process inks and film overlay materials shall be tested in accordance with, and meet all the performance requirements of ASTM D-4956, including Supplemental Requirement S2, Reboundable Sheeting Requirements, except as amended in this Section. Classification Type VII (Special) shall be tested in accordance with, and meet the performance requirements of ASTM D-4956 Type VIII, except as amended in this Section. For performance requirements that are color dependant, each color included in the QPL application must be tested and meet the requirements identified in ASTM D-4956 or this Section as applicable. Process inks and film overlay materials shall be applied to reflective sheeting in accordance with Section 994-4 for testing.

**994-3.2 Retroreflective Intensity:** The retroreflective sheeting shall meet the minimum initial requirements as stated for 0.2 degree and 0.5 degree observation angles

in ASTM D-4956. Type VI fluorescent pink sheeting and Type VII (Special) sheeting shall meet the minimum retroreflectivity requirements listed below.

| Type VII (Special) Sheeting<br>Minimum Coefficient of Retroreflection<br>(cd/foot-candle·ft$^2$)(cd/fc·ft$^2$) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Observation/Entrance Angle (degree) | White | Yellow | Red | Orange | Blue | Green | Brown | Fluorescent Orange | Fluorescent Yellow | Fluorescent Yellow/Green |
| 0.2/-4 | 380 | 304 | 95 | 250 | 19 | 38 | 19 | 180 | 220 | 360 |
| 0.5/-4 | 250 | 195 | 55 | 100 | 12 | 25 | 8 | 60 | 145 | 235 |
| 0.2/30 | 220 | 176 | 48 | 110 | 11 | 22 | 9 | 85 | 125 | 205 |
| 0.5/30 | 135 | 105 | 30 | 50 | 7 | 14 | 3 | 33 | 75 | 125 |

| Type VI Sheeting<br>Minimum Coefficient of Retroreflection<br>(cd/foot-candle·ft$^2$)(cd/fc·ft$^2$) | |
|---|---|
| Observation/Entrance Angle | Fluorescent Pink |
| (degree) | |
| 0.2/-4 | 160 |
| 0.5/-4 | 100 |
| 0.2/30 | 100 |
| 0.5/30 | 40 |

**994-3.3 Color:** The fluorescent pink initial color shall meet the following x, y chromaticity coordinates:

| Fluorescent Pink | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| x | .450 | .590 | .644 | .536 |
| y | .270 | .350 | .290 | .230 |

Fluorescent pink sheeting shall have a minimum luminance factor of 25.

**994-3.4 Outdoor Weathering**: Outdoor weathering exposure of sign sheeting materials shall be in accordance with, and meet the requirements of ASTM D-4956 for each product color and classification and conducted at an exposure location meeting the Tropical Summer Rain Climate Type (Miami, Florida or equivalent). Outdoor weathering is not required for Type VI fluorescent pink and fluorescent yellow.

**994-4 Direct and Reverse Screen Processing.**

The transparent and opaque process inks furnished for direct and reverse screen processing shall be of a type and quality formulated for retroreflective sheeting materials as listed on the QPL and applied in accordance with the manufacturer's instruction. Screen processing in accordance with the techniques and procedures recommended by the manufacturer shall produce a uniform legend of continuous stroke width of either transparent or opaque ink, with sharply defined edges and without blemishes on the sign background that will affect the intended sign use.

The retroreflective sheeting shall permit color processing with compatible transparent and opaque process inks as approved by the sheeting manufacturer and listed on the QPL.

**994-5 In-Service Minimum Requirements.**

The retroreflective sheeting and screen processed retroreflective sheeting shall have the minimum coefficient of retroreflection as shown in ASTM D-4956, Outdoor Weathering Photometric Requirements for All Climates except Type VI fluorescent pink and fluorescent yellow. In addition, Type VII (Special) classified sheeting materials shall have a minimum coefficient of retroreflection of 80% of the values listed in the above table. Only the observation angle of 0.2 degrees and an entrance angle of -4 degrees shall be used in measuring in-service minimums. The in-service life for opaque overlay films, black processing inks and opaque lettering shall equal the life of the reflective sheeting to which it is applied.

**994-6 Packaging and Labeling.**

Packaging and labeling shall meet the requirements of ASTM D-4956.

**994-7 Samples.**

Field samples will be obtained in accordance with the Department’s Sampling, Testing and Reporting Guide Schedule or on a random basis at the discretion of the Engineer.