

994 RETROREFLECTIVE AND NONREFLECTIVE SHEETING AND SIGN PANEL FABRICATION.

(REV 7-29-13) (FA 8-6-13) (1-14)

SECTION 994 (Pages 1146 – 1148) is deleted and the following substituted:

SECTION 994 RETROREFLECTIVE AND NONREFLECTIVE SHEETING ~~AND SIGN PANEL FABRICATION FOR TRAFFIC CONTROL DEVICES~~

994-1 Description.

994-1.1 General: This Section specifies the requirements for retroreflective and nonreflective *sheeting and sign panel materials and fabrication. This includes the sign* sheeting materials *such as;* transparent and opaque process inks for retroreflective sheeting materials, *vinyl* and *transparent* ~~film~~ overlays ~~for traffic control devices~~.

994-2 Retroreflective and Nonreflective Sheeting Systems.

994-2.1.2 Classification Materials: Retroreflective sheeting material ~~Types III, IV, V, VI and XI shall~~ be classified *in accordance with and meet the requirements of* ~~in accordance with~~ ASTM D4956. *Overlay materials must include colored and colorless transparent* ~~film~~ *overlays and vinyl. 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 D4956.*

994-2.2.3 Qualified Products List (QPL): All sheeting, process inks and ~~film~~ overlay materials ~~shall~~ be listed *as a system* on the Department's Qualified Products List (QPL). *Sign sheeting systems shall consist of base sheeting with ink and/or overlay materials. Products with an ASTM classification higher than Type IV of Type XI or greater will not be accepted for qualification on the QPL for fluorescent orange, fluorescent yellow and fluorescent yellow-green.* Manufacturers seeking evaluation of their products *need to* ~~shall~~ submit product data sheets, performance test reports from an independent laboratory showing the *product sign sheeting system* meets the requirements of this ~~s~~Section, and a QPL application in accordance with Section 6. Information on the QPL application must include the ~~product~~ *individual materials comprising the sign sheeting system and identify* colors ~~included in the application,~~ *ASTM base sheeting* classification, adhesive backing class, *availability of transparent and/or opaque backing* and *availability of liner types. Submit an infrared identification curve (2.5 to 15 μm) for each color of ink.*

~~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, and XI in ASTM D4956 or Type VII (Special) and fluorescent pink listed below in accordance with their approved usage.~~

994-2.3 Performance Requirements.

994-2.3.1 General: Sheeting, process inks and ~~film~~ overlay materials ~~shall~~*must* be tested in accordance with, and meet all the performance requirements of ASTM D4956, 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 D4956 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 D4956 or this Section as applicable. *Purple sign sheeting materials shall must meet the color requirements as identified in the MUTCD-23 CFR 665 Table 1 to Appendix to Part 655, Subpart F. All sign sheeting systems consisting of inks and/or overlays shall will be tested as a system consisting of white base sheeting and each color of ink and/or overlay.*

~~Process inks and film overlay materials shall be applied to reflective sheeting in accordance with Section 994-4 for testing~~*Panels for testing sheeting shall must be prepared in accordance with 994-3 for testing. The in-service life for the sign sheeting system shall will equal the life of the reflective base sheeting of the system.*

994-2.3.2 Retroreflective Intensity: The retroreflectivity ~~of sheeting and sheeting systems shall must~~ meet the minimum initial requirements as stated for ~~0.2-all degree and 0.5 degree~~ observation *and entrance* angles *as indentified in ASTM D 4956 in* ASTM D4956. ~~with an entrance angle of minus 4 degrees and plus 30 per ASTM D4956 shall be used. The 0.2 and 0.5 degree observation angles with an entrance angle of minus 4 degrees per ASTM D4956 shall will be used for in-service requirements. Purple sign sheeting materials shall must meet the retroreflectivity requirements as identified in the MUTCD-23 CFR-655 Table 1 to Appendix to Part 655, Subpart F.~~

Rotational sensitivity shall be tested in accordance with AASHTO M268. Rotationally sensitive sheeting will be noted on the QPL.

<i>Type VI Sheeting</i>	
<i>Minimum Coefficient of Retroreflection (cd/foot-candle·ft²)(cd/fc·ft²)</i>	
<i>Observation/Entrance Angle (degree)</i>	<i>Fluorescent Pink</i>
<i>0.2/-4</i>	<i>160</i>
<i>0.5/-4</i>	<i>100</i>
<i>0.2/30</i>	<i>100</i>
<i>0.5/30</i>	<i>40</i>

994-2.3.3 Colorless Overlay Films: *Colorless overlay film is allowed for the purpose of improving color retention. These films shall must be compatible with the sign sheeting system and not delaminate or discolor for the in-service life of the system. Submit the transmittance scan testing report performed across the wavelength range from 325nm to 700nm per ASTM D-1003 Procedure B. Colorless overlay films shall filter transmittance of electromagnetic radiation as follows:*

~~325nm — 370nm — 0.1% or less.~~

~~400nm to 700nm greater than 75%~~ 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/fe-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/fe-ft ²)	
Observation/Entrance Angle (degree)	Fluorescent Pink
0.2/4	160
0.5/4	100
0.2/30	100
0.5/30	40

994-2.3.43 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.

994-2.3.54 Outdoor Weathering: Outdoor weathering exposure of sign sheeting ~~systems materials shall~~ will be in accordance with, and meet the requirements of ASTM D4956 for each ~~system product~~, color and classification. ~~and All testing shall be~~ conducted at an exposure location meeting the Tropical Summer Rain Climate Type (Miami, Florida or equivalent). Outdoor weathering is not required for ~~purple and~~ 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 D4956, 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 minus 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.~~

994-2.3.6 Packaging and Labeling.

Packaging and labeling ~~shall~~**must** meet the requirements of ASTM D4956.

994-2.3.7 Samples.

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

994-3 Sign Panels.

994.3.1 Materials: *For aluminum sheets and plates for sign panels, meet the requirements of ASTM B 209, Aluminum Association Alloy 6061-T6, 5154-H38 or 5052-H38 and those shown in the Plans.*

994-3.2 Preparation of Sign Blanks.

994-3.2.1 De-greasing and Etching for Aluminum Sign Blanks:

994-3.2.1.1 General: *Prior to the application of retroreflective sheeting, use any of the methods shown below to de-grease and etch the aluminum sign blanks.*

994-3.2.1.2 Hand Method: *Under this method, de-grease and etch the blanks in one operation, using steel wool (medium grade) with any of the following combinations of materials:*

(1) An abrasive cleanser of a commercial grade kitchen scouring powder.

(2) Acid and a suitable detergent solution.

(3) An alkaline solution.

Thoroughly rinse the blanks with clean water following all hand de-greasing operations.

994-3.2.1.3 Power-Washer Method: *Under this method, de-grease the blanks with an inhibited alkaline cleanser, by spraying for 90 seconds with the solution between 135 and 249°F, the exact temperature to be as recommended by the manufacturer of the cleanser. After the spraying, rinse the blanks with clean water. Then etch the blanks by*

immersing them in a 6 to 8% solution of phosphoric acid at a temperature of 100 to 180°F for 60 seconds. After immersion, rinse the blanks in clean water.

994-3.2.1.4 Immersion Method: *Under this method, de-grease the blanks by immersing them in a solution of inhibited alkaline cleanser at a temperature between 160 and 180°F for three to five minutes, and then rinsing with clean water. Then etch blanks by immersing them in a 6 to 8% solution of phosphoric acid at a temperature of 100°F for three minutes. After immersion, rinse the blanks in clean water.*

994-3.2.1.5 Vapor De-greasing Method: *Under this method, de-grease the blanks by totally immersing them in a saturated vapor of trichloroethylene. Remove trademark printing with lacquer thinner or a controlled alkaline cleaning system.*

994-3.2.1.6 Alkaline De-greasing Method: *De-grease the blanks by totally immersing them in a tank containing an alkaline solution, controlled and titrated in accordance with the solution manufacturer's directions. Adapt immersion time to the amount of soil present and the thickness of the metal. After immersion, thoroughly rinse the blanks with running water.*

994-3.2.1.7 Etching Method when De-greasing is Separate Operation: *If using either of the de-greasing methods described in this section, accomplish etching by one of the following alternate methods:*

(1) Acid Etch: Etch well in a 6 to 8% phosphoric acid solution at 100°F, or in a proprietary acid etching solution. Rinse thoroughly with running cold water, which may be followed by a hot water rinse.

(2) Alkaline Etch: Etch aluminum surfaces in an alkaline etching material that is controlled by titration. Meet the time, temperature, and concentration requirements specified by the solution manufacturer. After completing etching is complete, rinse the panel thoroughly.

994-3.2.1.8 Cromate Coating: *Before applying retroreflective sheeting to the aluminum, treat the aluminum sign surfaces with cromate conversion coating. Coating may consist of an organic or inorganic cromate material. Coatings shall be applied according to the manufacturer's instructions and shall conform to ASTM B449, Class 2.*

994-3.3 Drying: *Dry the panels using a forced-air drier. Use a device or clean canvas gloves, to handle the material between all cleaning and etching operations and the application of retroreflective sheeting. Do not allow the metal to come in contact with greases, oils or other contaminants prior to the application of retroreflective sheeting.*

994-3.4 Fabrication of Sign Blanks: *Fabricate all metal parts to ensure a proper fit of all sign components. Complete all fabrication, with the exception of cutting and punching of holes, prior to metal de-greasing and applying the retroreflective sheeting. Cut metal panels to size and shape and keep free of buckles, warp, dents, burrs, and defects resulting from fabrication. Use aluminum sheets with increments of 4 feet in width; except, for sign widths that are not multiples of 4 feet. A maximum of two panels may be cut to less than 4 feet, and no panel may be cut to less than one foot. Mount aluminum sheets vertically and provide backing strips a vertical joints to keep the abutting sheets in proper alignment.*

Ship all multi-panel signs to the project intact, completely assembled and ready to be installed. Fabricate signs taller than 10 feet as two separate signs with a horizontal splice, ready to be spliced and installed.

994-3.5 Fabrication of Retroreflective Sign Faces.

994-3.5.1 General: Fabricate signs with sign sheeting systems listed on the QPL meeting the requirements in Section 700, Design Standards and Plans.

994-3.5.2 Application of Sheeting: Apply retroreflective sheeting to the base panels with mechanical equipment in a manner specified for the manufacture of traffic control signs by the sheeting manufacturer. ~~All sheeting identified as rotationally sensitive shall be applied in the optimum direction.~~ For sheeting that has been identified as rotationally sensitive, apply white sheeting for cut-out legends, symbols, borders and route marker attachments within the parent sign face at the optimum rotation angle according to the identification markings. Apply all background sheeting at a uniform rotational angle.

_____ The retroreflective sheeting for each sign ~~sh~~ will be from the same roll or lot number. Apply consecutively alternate successive width sections of either sheeting or panels to ensure that corresponding edges of sheeting lie adjacent on the finished sign. If the sign cannot be constructed from retroreflective sheeting from the same roll or lot number, the fabricator may color match from a different lot; the color between the rolls cannot exceed three ΔE 's using test method ASTM D 2244. The Engineer will not accept nonconformance that may result in non-uniform shading and an undesirable contrast between adjacent widths of applied sheeting or non optimum retroreflectivity in the finished sign and installation.

Sheeting is to be trimmed at 45° degree angle from the edge of each panel. Finish signs by sealing sheeting splices and sign edges according to sign manufacturer recommendations.

994-3.5.3 Direct and Reverse Screen Processing: Screen message and borders on retroreflective sheeting in accordance with the recommendations of the ink or overlay manufacturer. Process messages either before or after applying the sheeting to the base panels.

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~~ must 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.

994-3.5.4 Finished Sign Face: Provide finished signs with properly aligned clean cut and sharp messages and borders. Fabricated signs ~~shall~~ must be free of wrinkles, bubbles, foreign matter, scratches, free of patches, or other visually identifiable defects. Ensure that finished background panels are essentially a plane surface.

994-3.5.5 Packaging and Labeling: For permanent roadway signs, label the back of all finished panels at the bottom edge with "FDOT", the date of fabrication, sign sheeting system manufacturer, Type, and the fabricator's initials. Make the labels unobtrusive, but legible enough to be easily read by an observer on the ground when the sign is in its final position. Apply the label in a manner that is at least as durable as the sign face.

Properly package signs to protect them during storage, shipment and handling to prevent damage to the sign face and panel.