

**SECTION 994
RETROREFLECTIVE AND NONREFLECTIVE
SIGN SHEETING**

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 materials shall be classified in accordance with ASTM D4956. In addition, a Type VII reflective sheeting is added for a super high retroreflective sheeting with high performance angularity properties.

994-2 Materials.

Retroreflective sign 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 sheeting shall meet the requirements of Types III, IV, V, VI in ASTM D4956 or VII 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 Physical Requirements.

994-3.1 Testing: The retroreflective sheeting shall be tested in accordance with ASTM D4956 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 D4956. Evaluation of test samples shall be field tested in accordance with FM 5-571 for each color.

994-3.2 Retroreflective Intensity: The retroreflective sheeting shall meet the requirements in ASTM D4956 for the overall performance of each property listed. In addition to minimum coefficients of retroreflection listed in ASTM D4956, yellow-green fluorescent sheeting shall have a minimum coefficient of retroreflection of 200 at 0.2 /-4, 100 at 0.2 /30, 80 at 0.5 /-4 and 45 at 0.5 /30 (observation angle/entrance angle) for ASTM D4956 Tables 4, 5, 7 and 9. Type VII requirements are listed in Table 13 below.

994-3.3 Color: The retroreflective and nonreflective sheeting or film shall have the same daytime and nighttime color when viewed by reflective light regardless of type classification. The diffused color of the retroreflective sheeting, through instrumental color testing, shall conform to the requirements of ASTM D4956. In addition to ASTM D4956 Table 10, a yellow-green fluorescent color shall meet the following x, y chromaticity coordinates:

Fluorescent Yellow/Green	1	2	3	4
x	.387	.368	.421	.460
y	.610	.539	.486	.540

The daytime luminance for yellow-green fluorescent sheeting shall have a luminance factor of 35 minimum in addition to ASTM Table 8, respectively.

994-3.3.1 Accelerated Outdoor Test: The retroreflective and nonreflective materials shall meet the ASTM D4956 weathering requirements for performance. Retroreflective materials shall meet the minimum coefficient of retroreflection as listed in Table 11 in accordance with FM 5-571.

994-3.4 Adhesive Backing:

994-3.4.1 General: The adhesive backing of the retroreflective and nonreflective sheeting or film shall be either Class 1, Class 2 or Class 5 per ASTM D956, Section 4.3. 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.

994-3.4.2 Protective Liner: The protective liner over the adhesive backing shall be removable from the adhesive backing by peeling without soaking in water or other solvents and without breaking, tearing or removing any adhesive from the adhesive backing in accordance with ASTM D4956, Section 7.10.

994-3.5 Film: The exterior film of the sheeting shall be a flexible, smooth-surfaced, moisture-resisting material and shall have sufficient strength and flexibility to be easily handled, cut to shape, processed and applied without stretching, tearing, or other damage. In addition, retroreflective sheeting shall have a transparent exterior film.

994-3.6 Tensile Strength: The retroreflective and nonreflective sheeting or film shall have a minimum tensile strength of five pounds-force so that the sheeting can be handled, processed and applied without damage to sheeting. The tensile strength shall be tested in accordance with ASTM D882.

994-3.7 Physical Properties: The retroreflective and nonreflective sheeting or film material shall meet the ASTM D956 minimum requirements for specular gloss, shrinkage and flexibility.

994-3.8 Workability: The retroreflective and nonreflective sheeting or film shall permit pre-application handling, positioning, cutting by hand or die machine and oven drying. In addition, retroreflective sheeting shall permit color processing.

994-3.9 Chemical Resistance: The retroreflective and nonreflective sheeting or film shall be chemically resistant so as to permit cleaning with naphtha and mineral spirits, turpentine, mild soaps, detergents and alcohol.

994-3.10 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.

Table 13 Type VII Sheeting										
Minimum Coefficient of Retroreflection (cd/(Foot-candle ft ²)) [(cd/((lx m 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

Note: Tables 1-12 are found in ASTM D4956

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.

994-4.2 Retroreflective Intensity: Finished signs produced by the reverse screening process using transparent ink with retroreflective sheeting shall meet the minimums as specified in 994-3.2.

994-4.3 Color: The diffused 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 D4956, Table 11 for minimum coefficient of retroreflection using an observation angle of 0.2 degrees and an entrance angle of -4 degrees. In addition, Type VII sheeting materials shall have a minimum coefficient of retroreflection of 80% of the values listed in Table 13. The satisfactory predicted performance life for overlay films, black process inks and lettering shall equal the number of predicted performance life years of the retroreflective sheeting to which it is applied. Type III, IV, V and VII sheeting materials shall have a minimum performance life of at least ten years for each color except orange and fluorescent orange which shall have a minimum performance of at least three years and all other fluorescent colors which shall have a minimum performance of at least seven years. Performance life shall be based on the performance requirements of ASTM D4956 and FM 5-571.

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, type, color, quantity enclosed and date of manufacture. Show the type designation of the sheeting in accordance with ASTM D4956 and this Specification.

994-7 Certification.

The Contractor shall be required to furnish to the Engineer one certified test report from the sheeting manufacturer documenting that the retroreflective sheeting meets the requirements of this Section. The certified test report shall include test results for retroreflectivity, color, adhesive backing properties, film description, tensile strength, specular gloss, shrinkage, flexibility and chemical resistivity. The certified test report shall affirm the product meets all the requirements specified. If test results indicate significant inconsistencies in material properties, new qualification tests and/or comparison with original infrared spectroscopic values may be required. Each certification shall cover only one type of retroreflective or nonreflective sheeting or film. The certification shall meet the requirements in Section 6. Due to the wide range of applications of the products within some types, the certification shall additionally state that this product is recommended for use on this specified project.

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.

994-9 Samples.

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

