

SPECIAL PROVISIONAL SPECIFICATION: DIGITAL PRINT SYSTEMS

PERFORMANCE REQUIREMENTS FOR DIGITAL PRINT SYSTEMS

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1.0 **Scope**

This provisional specification covers digital print systems, which include flexible white or colored prismatic retroreflective sheeting (hereinafter called Sheeting), overlay films, and eco-solvent inks used in concert with a digital printer to fabricate durable traffic and work-zone signs and devices.

2.0 **Pre-qualification**

The digital print system (Sheeting, overlay films, eco-solvent inks, and digital printer) shall be considered for use when sufficient evidence exists to ensure that the system and services offered can reliably conform to this provisional specification.

3.0 **Classification and Conformance**

- 3.1 The digital print system shall be able to print on Sheeting using eco-solvent spot inks to produce durable traffic and work-zone signs and devices.
- 3.2 The Sheeting shall conform to ASTM D 4956-13 and AASHTO M268-13.
- 3.3 This specification supersedes all other specification if any variations exist.

4.0 **Items to be Included**

4.1 Digital Printer

The manufacturer of the sheeting shall offer a digital printer capable of printing on material as wide as 64 inches. The digital printer shall be able to house 8 cartridges or bags of eco-solvent inks which will be used to print on Sheeting to produce durable traffic and work-zone signs and devices. The digital printer shall include software and drivers necessary to design, edit, and RIP sign drawings as necessary.

The digital printer shall be installed and operated in a climate controlled environment between 68° F to 90° F, with relative humidity of 40% to 60% with no condensation. The digital printer shall be capable of operating on a standard dedicated electrical power line, providing 100-125V and 20 AMP.

The digital printer must include 2 staggered print heads, and feature variable dot technology to increase overall resolution and print quality. Minimum droplet size shall be 3.5 pl. Print heads shall be adjustable from 1.5mm to 4.00mm to allow various Sheeting types, and to eliminate risk of collision with splices.

4.2 Process Colors

The manufacturer of the Sheeting shall offer eco-solvent spot inks designed to work in concert with the digital print system. Ink shall be in containers and packaging described in section 5.6. For durable traffic colors, each color, on its own, shall be distinctly manufactured to meet daytime and luminance, and nighttime requirements outlined in section 5.1, as applicable to each color.

All standard traffic colors of Yellow, Black, Blue, Green, Red, and Brown shall be printed with durable eco-solvent spot inks. CMYK inks and colors shall only be used for graphic logos, non-regulated colors and imagery only.

4.3 Sheeting

All supplied Sheeting shall meet the requirements of ASTM D 4956-13. The Sheeting manufacturer shall be able to supply a broad range of Sheeting for various applications, including, but not limited to, ASTM Type IV, Type VIII, Type IX, and Type XI.

4.4 Overlay Films

The Sheeting manufacturer shall supply a clear acrylic overlay film, and an anti-graffiti clear acrylic overlay film. Application of either film is required in accordance with the Sheeting manufacturer's instructions to attain the performance, durability, and warranties stated in section 6.0.

4.5 Service and Training

The manufacturer shall warrant that the digital printer will perform according to the manufacturer's specifications and be free from defects in materials or workmanship for a period of one year from the date of original purchase. One year, parts and labor, on-site service shall be included with the purchase of the digital print system, as specified in section 6.1.

5.0 **Print Performance Requirements**

The digital printer shall be designed to work with the Sheeting manufacturer's Sheeting, overlay films, and eco-solvent inks as part of a complete system capable of printing durable traffic and work zone signs and devices.

Digital printer shall be able to print on rolls of Sheeting automatically fed through the printer by a motorized take-up system. Inks shall be dried by heaters from the bottom of the Sheeting and dry to the touch within 10 minutes of printing.

For traffic signs, the Sheeting manufacturer's clear acrylic overlay film shall be applied over the print of the eco-solvent inks on the Sheeting. Application of overlay shall be permissible any time after 2 hours of printing. When applied per manufacturer's recommendations, the finished product shall provide performance and durability in accordance with the Sheeting used and requirements outlined in this specification.

5.1 Color Requirements

Sheeting and printed signs produced using the digital print system shall meet the daytime color and luminance, and nighttime color requirements of ASTM D4956-13, as applicable to each color.

5.2 Coefficient of Retroreflection of sheeting

Conformance to minimum requirements for retroreflectance for the Sheeting and the digitally printed transparent colored areas on white Sheeting with overlay is determined as follows:

5.2.1 For the Sheeting, three 8 in. x 8 in. samples spaced evenly across and down a representative piece of Sheeting shall be taken. The Coefficient of Retroreflection (R_A) shall be determined for each of the three samples per ASTM E 810. Each 8 in. x 8 in. sample shall be measured with a rotation angle, Epsilon, of zero and ninety degrees. The average of the six values shall comply with the stated minimum table value and no single measurement shall be less than 80% of the table value.

5.2.2 The observation angles shall be 0.2°, 0.5° and 1.0°, as required in ASTM D 4956-13.

5.2.3 The entrance angles shall be -4° and 30°, as required in ASTM D 4956-13.

5.3 Coefficient of Retroreflection of Transparent Ink

The eco-solvent spot inks shall provide appropriate contrast, as required in the table below, when compared to the white Sheeting used:

Contrast requirements, expressed as a % of white base sheeting, to establish coefficient of retroreflection (RA) for area printed with transparent eco-solvent spot inks	
Ink Color	Minimum
Yellow	50
Blue	7
Green	13
Red	18
Brown	5

Coefficient of retroreflection measurements shall be taken on the same lot of Sheeting before and after printing. Measurements shall be taken at all ASTM D 4956 specified geometries.

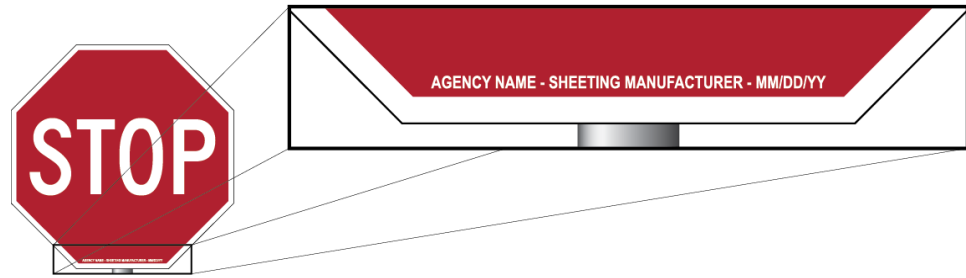
5.4 Rotational Sensitivity

To allow nesting of sign drawings and printing of signs and devices in multiple orientations, Sheeting shall meet the rotational sensitivity requirement of AASHTO M268-13, Section 3.3, as stated below:

When tested in accordance with ASTM E 810, the average coefficient of retroreflection (R_A) for a set of three samples taken from the same roll must not vary more than 20% between R_A measured at 0, 45, 90 and 120 degrees of rotation in order to be considered rotationally insensitive. The test shall be conducted at an observation angle of 0.5 degrees and an entrance angle of -4.0 degrees. Calculate the percent difference by dividing the absolute difference between $R_A(0)$ and $R_A(45)$ by $R_A(0)$. Repeat the calculation replacing $R_A(45)$ with $R_A(90)$ and $R_A(120)$. If the average of these three percent differences is less than 20%, the Sheeting is considered to be rotationally insensitive. $R_A(0)$ is established with the Sheeting aligned in its optimum rotation.

5.5 Sign Dating

The digital print system shall be able to legibly print the purchasing agency's name, the sheeting manufacture's name, and date of print on the face of the sign as small as 1/4" in height, as illustrated below:



For positioning of text and details of information refer to sign specification and drawings.

5.6 General Characteristics and Packaging

The Sheeting as supplied shall be of good appearance, free from ragged edges, cracks and extraneous materials, and shall be furnished in either rolls or sheets.

The Sheeting and eco-solvent inks shall be packaged in accordance with commercially accepted standards. Each carton shall clearly stipulate the brand, quantity, size, lot or run number, color and type adhesive, where applicable. Stored under sheeting manufacturer's recommended conditions the eco-solvent ink and Sheeting shall be suitable for use for a minimum period of one year as furnished.

Each ink carton shall contain individual 950 mL bags, 440 mL or 220 mL cartridges of eco-solvent ink. Each cartridge or bag shall be clearly labeled with the color, lot number, and date of manufacturing.

6.0 Durability & Warranty Requirements

6.1 Digital Printer Warranty

Each printer shall have a unique serial number which will be registered by the purchasing agency and the Sheeting manufacture at the time of installation. Components classified as consumables, or components required to be replaced in the course of routine maintenance as recommended by the sheeting manufacturer, may not be covered by the manufacturer warranty.

Damage caused by neglect or improper use of the printer as defined by the manufacture's recommendations may not be covered by the manufacturer's warranty.

6.2 Printed Sheeting Field Performance Requirements

Durable traffic signs printed with digital printers shall have a clear acrylic overlay film offered and warranted by the Sheeting manufacturer. Process colors that are not covered with the manufacturer's recommended clear acrylic overlay applied per the manufacturer's recommendations carry no performance warranty for permanent traffic signs.

CMYK inks shall carry no performance warranty.

Work-zone signs and devices shall not require a clear acrylic overlay film.

All measurements shall be made after sign cleaning in according with the

Sheeting manufacturer's recommendations.

Signs and devices will be considered unsatisfactory if they have deteriorated due to natural causes to the extent that: (1) the sign or device is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions; or (2) the coefficient of retroreflection is less than the values specified in ASTM D4956, as appropriate, at 0.2 degrees observation angle, -4 degrees entrance angle.

Natural causes include effects of exposure to weather. Natural causes exclude (without limitation) damage from exposure to chemicals, abrasion and other mechanical damage (such as from fasteners used to mount the sign, collisions or mishandling), vandalism or malicious mischief.

6.2.1 Durable Traffic Signing – Standard Colors:

Signs printed in standard traffic colors using eco-solvent spot inks and processed in accordance with the Sheeting manufacturer's recommendations shall perform effectively for at least the warranted life of the Sheeting.

6.2.2 Durable Traffic Signing – Fluorescent Yellow and Fluorescent Yellow-Green Colored Sheeting:

Fluorescent yellow and fluorescent yellow-green colored sheeting processed and applied to sign blank materials in accordance with the Sheeting manufacturer's recommendations shall perform effectively for at least 10 years for all sheeting types.

6.2.3 Temporary Work-Zone Signing

Signs and devices intended for work-zone usage processed in accordance with the Sheeting manufacturer's recommendations shall perform effectively for at least 3 years for all sheeting types.

Retroreflectivity shall meet 50% of values listed in ASTM D 4956-13, as required for each color and Sheeting.

6.3 Purchasing Agency Obligation

The purchasing agency shall be responsible for requiring the dating of all signs at the time of application, as required in 5.5. That date constitutes the start of the field performance obligation period.

7.0 **Applicable Documents**

The following documents, of issues in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

7.1 ASTM Standards:

D 4956-13 Standard Specification for Retroreflective Sheeting for Traffic Control

E 810 Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting

7.2 AASHTO Standards:

M268-13 Standard Specification for Retroreflective Sheeting for Flat and Vertical Traffic Control Applications