



CITY OF DETROIT

MIKE DUGGAN, MAYOR

SPECIFICATIONS FOR FURNISHING OF

Retroreflective Sign Sheeting Rolls, Precuts and Sign Manufacturing Accessories

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RETROREFLECTIVE SIGN SHEETING MATERIAL & ACCESSORIES

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SECTION 1

GENERAL CONDITIONS AND REQUIREMENTS

1.0 GENERAL CONDITIONS AND REQUIREMENTS

1.1 GENERAL CONDITIONS

1.1.1 Contract Intent

The City of Detroit intends to procure the services of qualified vendors to furnish **RETROREFLECTIVE SIGN SHEETING MATERIAL & ACCESSORIES.**

The vendor shall furnish finished retroreflective roll goods, precut sheets and accessories used for the fabrication of signs at City's Sign shop upon specific requests. The sign components shall be as described in the ensuing sections. All retroreflective sign sheeting shall meet the retro-reflective requirements of high-performance prismatic sheeting. (see Attachment #2 & #3) The services will be for a period of three (3) years.

It is the responsibility of the Bidder to review General Conditions as specified in the ensuing pages. All changes made to the bid form by way of altering prices, terms, quotes and/or conditions **MUST** be crossed out and initialed. Failure to initial any changes may be grounds for rejection of the bid.

Specifications referred to herein are used to indicate desired type, and/or construction, and/or operation. Other products and/or services may be offered if deviations from specifications are minor and if all deviations are properly outlined and stated in the bid document. Failure to outline all deviations may be grounds for rejection of the bid.

The decision of the City of Detroit, acting through the Purchasing Director, shall be final as to what constitutes acceptable deviations from specifications.

1.1.2 SCOPE OF WORK:

The City of Detroit intends to provide maintenance and replacement services for its various traffic control and parking control signs. With stated FHWA minimum levels of reflectivity requirements, the City of Detroit intends to be compliant by using state-of-the-art prismatic retro-reflective sheeting for all signs for better visibility and durability. Selection of sheeting materials and process type are specifically intended for improving legibility of all signs within the urban environment. Proper visibility at the range of 150 feet to 300 feet is critical owing to the location of the signs. All replacement signs are intended to exceed the FHWA minimum reflectivity levels by using (where specified) ASTM type X and Super High Efficiency Full Cube retro-reflective sheeting having the above-mentioned visibility profile as specified. The Vendor shall:

Furnish the following:

- Retroreflective Sign Sheeting Roll Materials and Accessories

All as indicated within the City of Detroit; including all labor, materials, supplies and use of equipment to fabricate and furnish in accordance with attached specifications. The vendor shall ship the rolls and accessories to City of Detroit sign shop located at 2425 Fenkell St.

The City of Detroit intends to have these supplies for Retro-reflective Sign Sheeting Roll Material and Accessories for inventory and replacement as required under all categories as described in the bid.

1.1.3 Schedule of Work and Work Plan:

Vendor shall supply the retro-reflective sign sheeting and/or roll goods to the City of Detroit within the prescribed time schedule as defined within each release order.

1.1.4 Duration of Contract:

The duration of the contract is three (3) years from the date of the award. The vendor is expected to make several shipments in a planned and timely manner to provide continuous work for the sign shop crew. The phased supply of all materials shall be completed within the specified days. A work stoppage due to lack of finished product will be considered as breach of condition of contract and will be grounds for termination.

The vendor shall be available to provide services during the entire duration of the contract regardless of any accelerated schedule he may propose.

1.1.5 Payment:

Vendors will be paid for completed segments of work monthly.

1.2 AWARD:

The Award shall be made to the overall responsible, specification meeting, low bidder for furnishing Retro-reflective Sign Sheeting Materials and Accessories. Bidders shall be required to provide unit prices for the shipping of materials to the City of Detroit's Sign Shop facility located at 2425 Fenkell St and be in full compliance with the requirements of the conditions.

1.3 VENDOR RESPONSIBILITY:

The awarded Vendor shall be responsible for the quality of all materials furnished. Any components that are deemed unacceptable due to defective workmanship, materials, or process shall be returned to the Vendor at No Cost to the City.

It shall be the Vendor's responsibility to ensure that all rolls/materials are packaged as specified herein.

1.4 WORK INCLUDED/MATERIALS & WORKMANSHIP:

The work included consists of supplying the retro-reflective sign sheeting and accessories. The sheeting shall meet the minimum coefficient of retroreflection specified in the detailed retroreflective sheeting specification in Section 3.3 Attachment 2 & 3. A complete listing of the roll dimensions, sizes and types will be furnished at the time of the release order.

The City reserves the right to delete, add or modify quantities required to be furnished. The successful bidder must obtain a written confirmation purchase order from Traffic Engineering Division prior to actual shipping. Each shipment will be strictly limited to the number of rolls ordered by the city in individual release order.

For details and requirements for shipping and handling refer to Section 3.

1.5 WORK SCHEDULE:

Each Bidder shall submit a firm schedule with their Bid. The schedule shall state the date and time to complete initial approval process and total time required to complete Contract. In any case, the total time required to complete shall not exceed one (1) year after the award of Contract. The bidder shall arrange a phased supply of signs as required by the Traffic Engineering Division. Failure to provide an acceptable schedule shall be sufficient grounds for rejection of any or all Bids.

SECTION 2

DEFINITION AND REFERENCES

2.1 Definitions

2.2 References

Section 2: Definition and References

2.1 Definition

2.1.1 ‘City’ means City of Detroit represented by Traffic Engineering Division, Department of Public Works, and its authorized agents.

“Vendor” means the contractor who has entered into a legal agreement with the City of Detroit for furnishing materials and/or for providing services per terms and conditions laid down for a fee agreed herein and documented thereof.

2.1.2 Roll goods means finished retro-reflective sign sheeting units produced in formats ranging in widths up to 48” and in lengths up to 100 yards.

2.1.3 Retro-Reflective sheeting referred to in this bid package means High Performance Prismatic - ASTM Type X and Super High Efficiency Full Cube Prismatic Sheeting

2.1.4 Precut sheets mean finished retroreflective sign sheeting units produced in formats ranging in length and widths up to 48”.

2.2 References

2.2.1 Prismatic Retroreflective sheeting. Refer to Attachment – 2 & 3 for specifications.

2.2.2 Accessories for fabrication. Refer to Section 3 and Attachment – 4, 5, 6, & 7 for specifications for process colors, EC film and other accessories for sign making.

2.2.3 Testing and certification requirements. Refer to Section 3.4 and Attachment- 8 for applicable specifications.

2.2.4 Performance Warranty: Refer to Section 3.5 and Attachment - 9

SECTION 3

Description of Materials/ Compatibility for Fabrication of Signs

3.1 Roll Good Dimension and Precut Sheets

3.2 General Components

3.3 Retroreflective Sheeting

3.4 Submittals and Acceptance Criteria

3.5 Warranty

City of Detroit Specification for

Retroreflective Sign Sheeting Rolls and Sign Manufacturing Accessories

3.1.1 Roll Good Dimension and Precut Sheets

Roll goods and precut sheets shall be supplied in specific sizes and retroreflective sheeting types as described in the release order(s). Any noncompliance shall be returned to Vendor at no cost to City.

3.2 General Components

All sign components shall follow the City of Detroit's specifications for traffic control signs and individual material specifications.

Retroreflective sheeting – Pressure Sensitive High Performance prismatic sheeting (ASTM Type X) and Super High Efficiency Full Cube prismatic retro-reflective sheeting as specified per bid item description and attached performance specifications.

3.3 Retro-reflective Sheeting

3.3.1 Retro-reflective Sheeting (Prismatic and Full Cube sheeting)

All retro-reflective sheeting to be utilized in the fabrication of pre-stenciled traffic control sign faces and pre-stenciled mounted traffic control signs as described in the ensuing sections shall conform to either High Performance Prismatic (ASTM type X sheeting) or Super High Efficiency Full Cube Prismatic retroreflective sheeting as indicated in the drawings and/or individual line items.

Due to the recently adopted FHWA minimum levels of reflectivity for traffic control signs, the use of high intensity prismatic technology will constitute the very minimum level of acceptable performance for the City of Detroit's signs. Also, to promote the benefit of improved, less pollutant manufacturing processes, City of Detroit's migration away from use of metalized retroreflective technologies of the past (such as Engineer Grade and Beaded High Intensity reflective sheeting) to more "environmentally green" technologies within prismatic products. See detailed specification at Attachment 2. Specifying the use of Super High Efficiency Full Cube Prismatic sheeting placed at high angularity locations, is due to an attribute of providing the highest retroreflectivity at short road distances as determined by R_A values at 1^0 observation angles. This sheeting is typically an un-metallized full cube microprismatic retroreflective element material, typically used for applications for permanent highway signs. See detailed specifications at Attachment 3.

Certain applications may require the use of a particular product within a specific level of performance to achieve a desired level of retroreflectivity in a given situation. In these cases, the City of Detroit will require information concerning additional performance characteristics. Typically, the legibility of the signs located on the right-hand side of the driver from distances ranging from 150 feet to 400 feet is critical. Minimum coefficient of retroreflection value requirements at various observation angles and entrance angles as illustrated (see Attachment 3) shall be strictly enforced. The Daytime Luminance factor shall comply with values laid down at table 6 ASTM D4956. 36-month accelerated weathering test values as established for this material shall conform to outdoor weathering requirements laid down in ASTM D4956 - 99.

3.3. 2 Packaging and Shipping

Rolls/accessories shall be packed in accordance with commercially accepted standards with sheeting manufacturer's recommendations. Materials shall be protected from moisture or other direct exposure to the element during shipment or storage. Rolls/material shall be sorted by categories and packaged separately. An identifier shall be affixed on top of each package describing in full the legend of the sign contained in the package.

3.4 Submittals and Acceptance Criteria

3.4.1 Approval Procedure

A minimum of five (5) samples of the reflective sheeting from each category shall be submitted for approval prior to shipping. The sampling shall be representative. The approved samples will be kept at the offices of the Traffic Engineering Division and shall form the basis for comparison and acceptance of all regular submittals. If required, City will define the exact category of sign chosen for representative sampling.

3.4.2 Testing Requirements:

Prior to commencement of the regular submittals, all required test data pertaining to the sign components shall be made available for review per Attachment 8. Test data shall be gathered by an independent agency, such as AASHTO's National Transportation Product Evaluation Program (NTPEP). Test data shall cover both the Retroreflective sheeting and process inks and/or overlay films manufactured by the sheeting manufacturer in standard traffic colors. Data collection shall have been completed no more than five (5) years prior to submission. As a minimum requirement, a 36-month outdoor weather test data for reflective sheeting shall be made available for review.

3.4.2.1 Test Panels and Test Conditions

Unless otherwise specified herein, sheeting shall be supplied to test panels in accordance with ASTM D 4956 section 8.2 and test conditions shall conform to ASTM D 4956 section 8.1.

3.4.3 Pre-Qualification and Acceptance Criteria

Acceptance criteria of Retroreflective sheeting for permanent signage shall meet the standards and guidelines laid down by Michigan Department of Transportation (MDOT). Please see attachment 5 "Acceptance Criteria" for details. MDOT requirements for Type material as attached is intended to establish minimum test requirements for retroreflective sheeting. Acceptance criteria for Type X sheeting and "Full cube Prismatic sheeting" may be more stringent. Pre-qualification of manufacturer of the sheeting shall be governed by Evaluation criteria laid down in the "City of Detroit Durable Sheeting Qualification Procedure" and proven capability to provide technical support for the product.

3.5 Warranty

The vendor shall procure and issue to the City a written warranty to ensure continual effectiveness of all installed signs during the entire life span of the signage (10 years). The warranty will cover the cost of restoring the sign to its original effectiveness at no cost to the City of Detroit for all materials including signage, substrate, installation hardware, support structures and anchors and labor for sign fabrication and reinstallation in the field, in the event of failure of the pre-stenciled face sheeting due to defective manufacture and /or fabrication. The primary warranty will be for a period of the first seven (7) years and will cover comprehensive replacement of signs to their original form. The secondary warranty will cover only the cost of the replacement of sheeting required to restore the sign surface to its original effectiveness. The secondary warranty will cover years 8, 9, and 10."

PARTICULAR SPECIFICATION FOR COMPONENTS AND FINISHED PRODUCT

Attachment 1 - Transfer Tapes
Attachment 2 – High Performance Prismatic (ASTM Type X) Retroreflective Sheeting
Attachment 3 – Super High Efficiency Full Cube Prismatic Retroreflective Sheeting
Attachment 4 – Electronic Cuttable Film
Attachment 5 – Protective Overlay Film
Attachment 6 – Testing and Certification Requirements
Attachment 7 - Warranty for Retroreflective Sign Sheeting Materials and Accessories

Attachment 1

Transfer Tapes

Transfer Tape/Pre-spacing Tape

Transfer Tape shall be supplied as a roll(s) and in various widths and lengths up to 52” width and maximum 100yds length per roll.

Transfer Tape shall be supplied with pressure sensitive adhesive on both clear and opaque films.

When the adhesive side is pressed down and placed over electronic cuttable film, the adhesive shall grip immediately.

The Transfer Tape shall include a liner that protects adhesive until ready for use.

To ensure compatibility, the City of Detroit requires the transfer tapes/pre-space tapes, EC Film, retro-reflective sheeting, and additional sign manufacturing accessories all be manufactured by the manufacturer of the approved retro-reflective sheeting.

ATTACHMENT #2

HIGH PERFORMANCE PRISMATIC (ASTM TYPE X) RETROREFLECTIVE SHEETING

City of Detroit

Specification for Un-metallized Micro-prismatic ASTM TYPE X High Performance Prismatic Retro-Reflective Sheeting for Durable Sign Faces

1.0 Scope

This specification covers flexible white or colored, prismatic retro-reflective sheeting (hereinafter called sheeting), and related processing materials designed to enhance nighttime visibility of traffic control signs and objects. The sheeting shall consist of cube corner prismatic optics encapsulated by a flexible transparent plastic film that has a smooth outer surface. The sheeting shall have a pre-coated adhesive protected by an easily removable liner.

The sheeting shall be part of a family of products required for the manufacture and imaging of traffic control signs as described in section 4. Imaged (printed or overlain) areas of signs are covered only by section 2.0, section 6.2, Table 1, section 6.3 and Table 2.

2.0 Prequalification and Performance History

Materials shall be considered for use only when, in the opinion of the agency, sufficient evidence exists to ensure that the materials and services offered can reliably conform to this specification. The sheeting manufacturer shall provide evidence of performance and suitability for use in accordance with the Agency's Qualified Products Procedures

3.0 Classification and Conformance

The sheeting shall meet the performance requirements contained in *all* of the standards and specifications listed below, as modified herein. The sheeting need not conform to any construction or composition limitations included in the reference specifications; and the retro-reflectance measurements shall be limited to observation angles less than 2.0°.

ASTM D 4956 (Type III, Type IV, Type X)	BS 873 Class 1
AASHTO M 268 (Type III, Type IV, Type X)	AS/NZ 1906.1 Class 1
CGSB 62-GP-11 Type 1	DIN 67520 Type 2
EN 12899-1 Class 2	JT/T 279 Class 3
GB/T 18833 Class 3	NTC 4739 Type III and IV
NBR 14644 Type II	SABS 1519.1 Class III

- 3.1 The adhesive shall be a pressure-sensitive adhesive of the aggressive tack type requiring no heat, solvent, or other preparation for adhesion to smooth, clean

surfaces when properly applied at temperatures above 65°F. For application to rough surfaces, a surface primer may be required.

4.0 Imaging Systems

4.1 Process Inks

4.1.1 The process colors shall be a single line of traffic colors which may be applied before and after the sheeting is applied to a substrate; require no component premixing; and will air dry for packing in 4 hours or less and requires no clear coating.

4.2 Overlay Films: The sheeting manufacturer shall also manufacture colored imaging films and clear protective overlays, which are compatible with the sheeting, and when used in accordance with the sheeting manufacturer's instructions shall not lessen the warranty term as described in section 7.2.

5.0 Test Panels and Test Conditions

Unless otherwise specified herein, when tests are to be performed using test panels, the specimens shall be applied to smooth aluminum 0.020 in. (0.508 mm), 0.040 in. (1.016 mm) or 0.063 in. (1.600 mm) in thickness cut from Alloy 6061-T6 or 5052-H38. The aluminum shall be de-greased and lightly acid etched before the specimens are applied. Unless otherwise specified, all test samples shall be conditioned for 24 hours prior to testing and all tests shall be conducted at a temperature of $73 \pm 3^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$) and $50 \pm 5\%$ relative humidity.

6.0 Material Requirements

6.1 Color Requirements: Color shall be as specified and shall conform to the requirements for standard highway colors as defined by all the standards and specifications listed in section 3.0 above.

6.2 Coefficient of Retro-reflection: The coefficients of retro-reflection shall be determined in accordance with ASTM E-810, for the minimum requirements of Table 1, as specified.

6.2.1.1 Units: Coefficients of retro-reflection shall be specified in units of candelas per lux per square meter. The observation angles shall range from 0.2° to 1.0° . The entrance angles shall range from -4° to 40° .

- 6.2.1.2 For screen printed transparent colored areas on white sheeting, the coefficients of retro-reflection shall not be less than 70% of the values for corresponding color in the above table. Standard traffic colors not available in integrally colored sheeting may be produced using acrylic overlay films.
- 6.3 Color Processing: The retro-reflective sheeting shall be designed to work in concert with recommended imaging systems. Color processing with compatible transparent and opaque process colors shall be possible in accordance with the sheeting manufacturer's recommendation at temperatures of 66 to 100°F (16 to 38°C) and relative humidity of 20 to 80%. The sheeting shall be heat resistant and permit force curing without staining of applied or unapplied sheeting at temperatures recommended by the sheeting manufacturer.
- 6.4 Flexibility: The reflective sheeting shall be sufficiently flexible to show no cracking during application to substrates in accordance with the manufacturer's instructions.
- 6.5 Adhesion: The retro-reflective sheeting shall comply with the liner removal and adhesion requirements contained in the standards and specifications listed in section 3.0.
- 6.6 Impact Resistance: The retro-reflective sheeting shall comply with the impact resistance requirements contained in the standards and specifications listed in section 3.0.
- 6.7 Resistance to Accelerated Weathering: The retro-reflective sheeting shall comply with the weathering resistance requirements contained in the standards and specifications listed in section 3.0.
- 6.8 Resistance to Heat, Cold and Humidity: Three samples of retro-reflective sheeting, 3 x 6 inch, applied to test panels in accordance with section 5.0 above, shall be exposed as follows:
- 6.8.1 Heat: One specimen shall be placed in an oven at $160^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ($71^{\circ}\text{C} \pm 3^{\circ}\text{C}$) for 24 hours, then conditioned as in section 5.0 for 2 hours.
- 6.8.2 Cold: The second specimen shall be exposed to an air temperature of $-70^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ($-57^{\circ}\text{C} \pm 3^{\circ}\text{C}$) for 72 hours, then conditioned as in section 5.0 for 2 hours.
- 6.8.3 Humidity: The final specimen shall be subjected to 100% relative humidity at a temperature of $75^{\circ} - 78^{\circ}\text{F}$ ($23^{\circ} - 27^{\circ}\text{C}$) in accordance with US Federal Test Method Standard 141, method 6201, for 24 hours, then conditioned as in section 5.0 for 24 hours.

Examination of each of the three samples following the exposures shall show no evidence of cracking, peeling, chipping or delamination from the test panel. After heat exposure the sheeting shall retain a minimum of 85% and a maximum of 115% of the original coefficient of retro-reflection when measured at room temperature.

Table 1
Minimum Coefficient of Retro-reflection
(Candelas per Lux per Square Meter)

White

	-4/5	30	40
0.2	560	280	90
0.5	200	100	45
1.0	20	10	9.0

Green

	-4/5	30	40
0.2	56	30	8
0.5	21	12	3.0
1.0	2.0	2.0	0.8

Yellow

	-4/5	30	40
0.2	420	210	65
0.5	150	75	32
1.0	14	8.5	7.0

Blue

	-4/5	30	40
0.2	30	14	5.0
0.5	13	6.0	2.0
1.0	1.0	0.8	0.5

Red

	-4/5	30	40
0.2	84	42	15
0.5	30	15	7
1.0	3.0	2.0	1.0

Brown

	-4/5	30	40
0.2	18	8.5	2.0
0.5	7.5	3.5	1.0
1.0	1.0	0.2	0.1

Orange

	-4/5	30	40
0.2	210	105	29
0.5	75	37	14
1.0	5.0	3.0	1.0

7.0 Performance Requirements and Obligations

7.1 Certification. The sheeting manufacturer shall submit with each lot or shipment, a Certification that states that the material supplied will meet all the requirements listed herein.

7.2 Field Performance Requirements

Sheeting processed and applied to sign blank materials in accordance with sheeting manufacturer's recommendations, shall perform effectively for the number of years stated in Table 2 of this specification. The retro-reflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions; or (2) the coefficient of retro-reflection is less than the minimum specified for that sheeting during that period listed in Table 2. All measurements shall be made after sign cleaning according to sheeting manufacturer's recommendations.

Table 2
Minimum Coefficient of Retro-reflection
Candelas per Lux per Sq-Meter
(.2° obs, and -4° entrance)

Sheeting Color	Minimum Coefficient of Retro. (7 years) ¹	Minimum Coefficient of Retro. (10 years)
White	450	390
Yellow	336	294
Green	45	39
Red	67	59
Blue	24	20
Brown	14	12
Orange	165	147

For screen printed transparent colored areas on white sheeting, the coefficients of retro-reflection shall not be less than 70% of the values for the corresponding color in the above table.

¹ When sheeting is used in temporary work zone applications the warranty period shall be limited to 3 years

7.3 Sheeting Manufacturer's Replacement Obligation

Where it can be shown that retro-reflective traffic signs manufactured with sheeting supplied and used according to the sheeting manufacturer's recommendations have not met the performance requirements of Section 7.2 due to internal defects, the sheeting manufacturer shall cover restoration costs as follows for sheeting shown to be unsatisfactory during:

7.3.1 The entire ten years (three years for work zone materials): the sheeting manufacturer will replace the sheeting required to restore the sign surface to its original effectiveness.

7.3.2 In addition, during the first seven years (excluding work zone materials): the sheeting manufacturer will cover the cost of restoring the sign surface to its original effectiveness at no cost to the using Agency for materials and labor.

7.4 Government Using Agency Obligation

The using Agency shall be responsible for requiring the dating of all signs at the time of application. That date constitutes the start of the field performance obligation period.

8.0 Technical Assistance Requirement

The manufacturer supplying the retro-reflective sheeting shall provide at no charge the services of a qualified technician for instruction and training at the primary sign manufacturing facility or other centers designated by the City. This instruction shall be provided biannually and at the request of the City. Instruction shall include but not be limited to training films, material application, equipment operation, silk screening techniques, packaging, storage, and other proven sign shop practices as they apply to the reflective sheeting supplied by the manufacturer, and to assure that the resulting signs can comply with the applicable specifications.

Additional on-site technical assistance from the manufacturer supplying the retro-reflective sheeting shall be provided at each of the sign shops designated in the bid invitation. This assistance shall be provided annually and at the request of the Agency.

The sheeting manufacturer shall, without additional cost to the Agency, provide the sign shops with competent technical service and product information, including service on screen printing problems with the inks furnished or recommended by the manufacturer for their sheeting. The manufacturer supplying the retro-reflective sheeting shall provide technical assistance for their recommended sheeting application equipment. The manufacturer shall certify that trained personnel will be available on 72 hours notice to render such a service to facilitate the manufacture of finished signs. "Service" is understood to mean the capability of calibration and troubleshooting, as well as the training and retraining of personnel as required. In addition, a manufacturer's representative shall be available on site within 24-hour notice to assess and advise on any manufacturing difficulty that arises.

9.0 Applicable Documents

The following documents, of the 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.

9.1 ASTM Standards

9.1.1 B 209 Specification for Aluminum and Aluminum Alloy Sheet and Plate.

9.1.2 D 523 Standard Method for Test for Specular Gloss.

9.1.3 D 4956 Standard Specification for Retro-reflective Sheeting for Traffic Control.

9.1.4 E 284 Standard Definition of terms Relating to Appearance of Materials.

9.1.5 E 308 Standard Method for computing the colors of objects by using the CIE system.

9.1.6 E 810 Standard Test Method for Coefficient of Retro-reflection of Retroreflective Sheeting.

9.1.7 E 1164 Standard Practice for obtaining spectrophotometric data for object color evaluation.

9.2 Other Standards

9.2.1 AASHTO M 268 Standard Specification for Retro-reflective Sheeting for Traffic Control

9.2.2 FHWA FP-96 Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects

Attachment # 3

***SPECIFICATION FOR
SUPER-HIGH EFFICIENCY FULL CUBE
PRISMATIC RETROREFLECTIVE SHEETING***

City of Detroit
Specification for Super-High Efficiency Full Cube Prismatic
Retroreflective Sheeting for Durable Signing

1.0 Scope

This provisional specification covers flexible white or colored, Super-High Efficiency Full Cube Retroreflective Sheeting (hereinafter called sheeting), tape and related processing materials designed to enhance nighttime visibility of traffic control signs and objects. The sheeting shall consist of full cube prismatic lens elements with a distinctive interlocking diamond seal pattern visible from the face of a smooth surface. The sheeting shall have a pre-coated adhesive protected by an easily removable liner.

The sheeting shall be part of a family of matched component products required for the manufacture and imaging of traffic control signs as described in section 4. Only section 2.0, section 6.2.5, section 6.4, and section 7.2 cover printed colored areas of signs.

2.0 Prequalification

Materials (sheeting, process colors, overlay films) shall be considered for use only when, in the opinion of **City of Detroit**, sufficient evidence exists to ensure that the materials and services offered can reliably conform to this provisional specification.

3.0 Classification and Conformance

3.1 The sheeting shall conform to ASTM D 4956-05 as modified by this special provision.

4.0 Compatible Components

4.1 Process Colors

4.1.1 The manufacturer of the sheeting shall manufacture and offer process colors in standard traffic colors, clears and thinners recommended for the sheeting to meet the performance requirements of this specification.

4.1.2 The process colors shall be a single line of traffic colors which may be applied before and after sheeting is applied to a substrate, require no component premixing, and will air dry for packing with proper ventilation in 3 hours or less and require no clear coating.

4.2 Overlay Films

The sheeting manufacturer shall also manufacture colored acrylic imaging films and clear protective overlays, which are compatible with the sheeting, and when used in accordance with the sheeting manufacturer's instructions, shall not lessen the warranty term as described in section 7.2.

5.0 Test Panels and Test Conditions

Unless otherwise specified herein, sheeting shall be applied to test panels in accordance with ASTM D 4956-05, section 7.2 and test conditions shall conform to ASTM D 4956-05 section 7.1.

6.0 Requirements

6.1 Color Requirements

6.1.1 Colors

Color shall be as specified and shall conform to the requirements of ASTM D 4956-05, Table 17. Luminance factors shall conform to Table 10 for ordinary colors and Table 14 for fluorescent colors.

6.1.1.1 Ordinary Colors

Conformance to standard chromaticity (x, y) and luminance factor (Y%) requirements shall be determined by instrumental method in accordance with ASTM E 1164 on sheeting applied to smooth aluminum test panels cut from Alloy 6061-T6 or 5052-H38. The values shall be determined on a HunterLab ColorFlex 45/0 spectrophotometer. Computations shall be done for CIE Illuminant D65 and the 2° standard observer. *

6.1.1.2 Fluorescent Colors

Conformance to standard chromaticity (x,y) and luminance factor (Y%) requirements shall be determined by instrumental method in accordance with

ASTM E 991 on sheeting applied to smooth aluminum test panels cut from Alloy 6061-T6 or 5052-H38. The values shall be determined on a HunterLab ColorFlex 45/0 spectrophotometer. Computations shall be done for CIE Illuminant D65 and the 2° standard observer. *

* The instrumentally determined color values of ordinary and fluorescent colored retroreflective sheeting can vary significantly depending on the make and model of colorimetric spectrophotometer as well as the color and retroreflective optics of the sheeting (David M. Burns and Timothy J. Donahue, Measurement Issues in the Color Specification of Fluorescent-Retroreflective Materials for High Visibility Traffic Signing and Personal Safety Applications, Proceedings of SPIE: Fourth Oxford Conference on Spectroscopy, 4826, pp. 39-49, 2003). For the purposes of this document, the HunterLab ColorFlex 45/0 spectrophotometer shall be the referee instrument.

6.2 Coefficient of Retroreflection

6.2.1 Conformance to minimum requirements for Retro-reflectance is determined as follows:

6.2.2 Three 8 in. x 8 in. samples spaced evenly across and down a representative piece of sheeting shall be taken. The Coefficient of Retroreflection (Ra) shall be determined for each of the three samples per ASTM E810. The average of the three values shall comply with the stated minimum table value and no single sample shall be less than 80% of the table value.

6.2.3 The observation angles shall be 0.2°, 0.5°, 1.0°.

6.2.4 The entrance angles shall be -4° and 30°.

6.2.5 For screen printed transparent colored areas or transparent colored overlay films on white sheeting, the coefficients of retroreflection shall not be less than 70% of the values for corresponding color in Table I.

6.3 Fractional Retro-reflectance

The optical design of the sheeting shall be such that when measured at an entrance angle of -4° the fractional retro-reflectance within a 2° observation angle cone, as defined in ASTM E808 as R_T with $\alpha_{max} = 2^\circ$, is at least 55%.

Table I
Minimum Coefficient of Retroreflection
(cd/lux/m²)

White	-4	30
0.2	570	215
0.5	400	150
1.0	120	45

Blue	-4	30
0.2	26	10
0.5	18	6.8
1.0	5.4	2.0

Yellow	-4	30
0.2	425	160
0.5	300	112
1.0	90	34

FYG	-4	30
0.2	455	170
0.5	320	120
1.0	96	36

Red	-4	30
0.2	114	43
0.5	80	30
1.0	24	9

FY	-4	30
0.2	340	130
0.5	240	90
1.0	72	27

Green	-4	30
0.2	57	21
0.5	40	15
1.0	12	4.5

FO	-4	30
0.2	170	64
0.5	120	45
1.0	36	14

6.4 Color Processing

The retroreflective sheeting shall be designed to work in concert with recommended imaging systems. Color processing with compatible transparent and opaque process colors shall be possible in accordance with the sheeting manufacturer's recommendation at temperatures of 60° to 100°F (16° to 38°C) and relative humidity of 20% to 80%. The sheeting shall be heat resistant and permit force curing without staining of applied or unapplied sheeting at temperatures recommended by the sheeting manufacturer.

6.5 Shrinkage

The retroreflective sheeting shall comply with the shrinkage requirements contained in ASTM D 4956-05 section 6.6.

6.6 Adhesive

The retroreflective sheeting shall comply with the liner removal and adhesion requirements contained in ASTM D 4956-05 sections 6.8 and 6.9 respectively.

6.7 Optical Stability

Three samples of retroreflective sheeting applied to test panels and conditioned as in Section 5.0 shall each first have their photometric properties characterized by measuring the coefficients of retroreflection in accordance with ASTM E 810 at all test geometries shown in Table I. These panels shall then be exposed in an air circulating oven at $160 \pm 5^\circ\text{F}$ ($71 \pm 3^\circ\text{C}$) for a period of 24 hours. After exposure the panels shall be allowed to condition according to the provisions of Section 5.0. These panels will again be characterized for photometric properties by measuring the coefficients of retroreflection at all test geometries measured before exposure.

The coefficients of retroreflection measured after exposure shall be between 85% and 115% of the values measured before exposure for each of the three samples.

6.8 Fungus resistance

The retroreflective sheeting shall comply with the supplementary requirements contained in section S1 of ASTM D 4956-05.

6.9 General Characteristics and Packaging

The retroreflective 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.

When furnished in continuous rolls, the number of splices shall not be more than two per 50 yards (45.7 m) of material, with a maximum of three pieces in any 50-yard (45.7 m) length. Splices shall be butted or overlapped and shall be suitable for continuous application as furnished.

The sheeting 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. Stored under normal conditions, the

retroreflective sheeting as furnished shall be suitable for use for a minimum period of one year.

7.0 Performance Requirements and Obligations

7.1 Certification

The sheeting manufacturer shall submit with each lot or shipment a certification that states the material supplied will meet all the requirements listed herein.

7.2 Field Performance Requirements

7.2.1 For Permanent Signing – Ordinary Colors:

Sheeting manufactured of ordinary colors and processed and applied to sign blank materials in accordance with sheeting manufacturer's recommendations, shall perform effectively for at least 12 years. The retroreflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign 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 minimum specified for that sheeting during that period listed.

80% of values listed in Table I up to 7 years and
70% of values listed in Table I up to 12 years.

Failure of process colors or overlay films provided and/or sold for use on recommended sheeting shall constitute a failure of the sign and shall be replaced under the manufacturer's replacement obligations (7.3).

For screen printed transparent colored areas or transparent colored overlay films on white sheeting, the coefficients of retroreflection shall not be less than 70% of the values for the corresponding integral color.

All measurements shall be made after sign cleaning according to the sheeting manufacturer's recommendations.

7.2.2 For Permanent Signing – Fluorescent Colors:

Sheeting manufactured of fluorescent colors and processed and applied to sign blank materials in accordance with sheeting manufacturer's recommendations shall perform effectively for the number of years stated in this specification. The retroreflective sheeting will be

considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign 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 minimum specified for that sheeting during that period listed.

80% of values listed in Table I up to 7 years* and
70% of values listed in Table I up to 10* years.

Failure of process colors or overlay films provided and/or sold for use on recommended sheeting shall constitute a failure of the entire sign and shall be replaced under the manufacturer's replacement obligations (7.3).

All measurements shall be made after sign cleaning according to the sheeting manufacturer's recommendations.

* 5 years in states listed in Table II
* 7 years in states listed in Table II

<p align="center"><u>Table II</u> Minimum Total Luminance Factor (All measurements shall be made after cleaning according to manufacturer's recommendations)</p>		
Color	Warranty Period	Minimum Total Luminance Factor Y _T %
Fluorescent Yellow	10 Years*	45%
Fluorescent Yellow Green	10 Years*	60%

*Due to climatic conditions, the warranty in the following states will be a seven year warranty: Alabama, Arizona, Florida, Georgia, Hawaii, Louisiana, Mississippi, New Mexico, South Carolina, Texas

7.2.3 For Temporary Signing – Fluorescent Orange Colors

Sheeting manufactured of fluorescent orange and applied to sign blank material in accordance with the sheeting manufacturer's recommendations, is expected to perform effectively for a minimum of three years. The retroreflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign is ineffective for its intended purpose or (2) retains less than 50% of the coefficient of retroreflection values listed in Table I at 0.2 degrees observation, -4 degrees entrance (measured in accordance with ASTM E810).

All measurements shall be made after sign cleaning according to the sheeting manufacturer's recommendations.

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.

7.3 Sheeting Manufacturer's Replacement Obligation

7.3.1 For ordinary colors where it can be shown that retroreflective signs, supplied and used according to the sheeting manufacturer's recommendations, have not met the performance requirements of Section 7.2, the sheeting manufacturer shall cover restoration costs as follows for sheeting shown to be unsatisfactory during:

7.3.1.1 For the entire 12 years, the sheeting manufacturer will replace the sheeting required to restore the sign surface to its original effectiveness.

7.3.1.2 In addition, during the first seven years the sheeting manufacturer will cover the cost of restoration of the sign surface to its original effectiveness at no cost to **(Agency)** for materials and labor.

7.3.2 For fluorescent colors where it can be shown that retroreflective signs, supplied and used according to the sheeting manufacturer's recommendations, have not met the performance requirements of Section 7.2, the sheeting manufacturer shall cover restoration costs as follows for sheeting shown to be unsatisfactory:

7.3.2.1 For those states with a 10-year warranty, if the failure occurs within the first 7 years from the date of fabrication, the sheeting manufacturer shall, at its expense, restore the sign surface to its original effectiveness.

7.3.2.2 If the failure occurs in the 8th through the 10th year from the date of fabrication, the sheeting manufacturer will furnish the necessary amount of sheeting to restore the sign surface to its original effectiveness.

7.3.2.3 Replacement sheeting shall carry the unexpired warranty of the sheeting it replaces.

7.3.2.4 For those states with a 7-year warranty, if the failure occurs within the first 5 years from the date of fabrication, the

manufacturer will, at its expense, restore the sign surface to its original effectiveness.

7.3.2.5 If the failure occurs within the 6th or 7th year from the date of fabrication, the manufacturer will furnish the necessary amount of sheeting necessary to restore the sign surface to its original effectiveness.

7.3.2.6 Replacement sheeting shall carry the unexpired warranty of the sheeting it replaces.

7.3.3 For temporary signing, fluorescent orange, where it can be shown that the retroreflective sheeting fails to conform to the performance requirements of Section 7.2, the sheeting manufacturer's sole responsibility and purchaser's and user's exclusive remedy shall be:

7.3.3.1 Provide replacement sheeting. This sheeting shall carry the unexpired warranty of the sheeting it replaces.

7.4 **City of Detroit Requirement for Date Stamping of all Signs**

The City of Detroit requires that all signs be date-stamped at the time of application. That date constitutes the start of the field performance obligation period. The date shall be screened in or processed through EC film application and shall be in the outer periphery of the sign in a format depicting month and year of installation.

8.0 **Applicable Documents**

The following documents, of the 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.

8.1 **ASTM Standards**

8.1.1 D 4956 Standard Specification for Retroreflective Sheeting for Traffic Control.

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

ATTACHMENT #4

***SPECIFICATION FOR
ELECTRONIC CUTTABLE FILM
(EC FILM)***

City of Detroit

Specification for Electronic Cuttable Film for Use on Retroreflective Sheeting

1.0 Scope

This document covers highly durable, transparent, acrylic, pressure sensitive colored film designed to be applied to retroreflective materials for the creation of traffic control signs and devices.

2.0 Performance History

2.1 The sheeting manufacturer shall provide test data showing that representative production material of the type to be supplied has met the requirements for 36 months of accelerated outdoor weathering described in Section 6.6.

2.2 This data shall be gathered by an independent agency, such as AASHTO's National Transportation Product Evaluation Program (NTPEP).

2.3 The data submitted shall cover the films manufactured by the sheeting manufacturer in standard traffic colors and the data collection shall have been completed no more than 5 years prior to the offer.

2.4 To be considered an equal alternative to an existing, qualified product, a candidate product must be used or weathered along side the control or benchmark material to eliminate any bias in the exposure procedures.

3.0 Applicable Documents

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

3.1 ASTM Standards

3.1.1 B 209 Specification for Aluminum and Aluminum Alloy Sheet and Plate.

3.1.2 D 523 Standard Method for Test for Specular Gloss.

3.1.3 D 4956 Standard Specification for Retroreflective Sheeting for Traffic Control

3.1.4 E 284 Standard Definition of Terms Relating to Appearance of Materials.

3.1.5 E 308 Computing the Colors of Objects by Using the CIE System.

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

3.1.7 E 1164 Standard Practice for Obtaining Spectrophotometric Data for Object-Color Evaluation.

3.2 CIE Publication Number 39-2, Recommendation for Surface Colors for Visual Signaling.

3.3 FP-92 Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects.

4.0 Description

Electronic cuttable films shall consist of highly durable, transparent, acrylic-colored films coated with a transparent pressure sensitive adhesive protected by a removable translucent, synthetic, release liner. The films are designed to be cut on knife over roll (sprocket fed or friction fed) and flat bed electronic cutting machines. The films shall be available in standard traffic colors, be dimensionally stable, and be designed to optimally cut, weed, lift, and transfer. Use of electronic cuttable films will not require the using agency to release any volatile organic compounds.

5.0 Test Methods

5.1 Test Conditions. Unless otherwise specified herein, all applied and unapplied test samples and specimens shall be conditioned at the standard conditions of $73 \pm 3^{\circ}$ F ($23 \pm 1.5^{\circ}$ C) and $50 \pm 5\%$ relative humidity for 24 hours prior to testing.

5.2 Test Panels. Unless otherwise specified herein, when tests are to be performed using test panels, the specimens of retroreflective and/or overlay film(s) shall be applied to smooth aluminum cut from ASTM B-209 Alloy 5052-H36, 5052-H38, 5154-H38, or 6061-T6 sheets on 0.020-inch (0.051 cm), 0.040 inch (0.102 cm), or 0.063 inch (0.160 cm) thickness. The aluminum shall be degreased and lightly acid etched before the specimens are applied. The specimens shall be applied in accordance with the recommendations of the reflective sheeting and electronic cuttable film manufacturer(s).

6.0 Physical Requirements

6.1 Color Requirements. When electronic cuttable film is applied to retroreflective sheeting, the resulting color of the composite sheeting will conform to Federal Specification FP-92, Section 718.01 and ASTM D 4956 or to the using agency specification for the appropriate retroreflective sheeting to which it is applied.

6.1.1 Color Test. Conformance to color requirements shall be determined by instrumental method in accordance with ASTM E 1164 on sheeting applied to aluminum test panels. The values shall be determined on a HunterLab Labscan 6000 0/45 Spectro colorimeter with option CMR 559 [or approved equal 0/45 (45/0) instrument with circumferential viewing (illumination)]. Computations shall be done in accordance with ASTM E 308 for the 2° observer.

6.2 Coefficient of Retroreflection, R_A . When transparent colored electronic cuttable film is applied per the manufacturer's recommendations over white retroreflective sheeting, the colored composite will conform to the percentage specified in Table 1. The coefficient of retroreflection shall be determined in accordance with ASTM E 810.

Table 1		
Coefficient of Retroreflection R_A * for Applied E.C. Films (Expressed as % of white retroreflective sheeting background)		
Transparent Color	Minimum	Maximum
Green	13.0	20
Blue	6.5	20
Red	14.0	24
Yellow	60.0	80
Orange	30.0	-
Brown	5.0	-
Blue-Violet	1.4	-
Dark Green**	8.0	14

* R_A (cd/lux/m²) measurements shall be made at 0.2° observation angle, -4° entrance angle, and 0° rotation, per ASTM E-810.
 ** Standard green color for U.K., Australia, and New Zealand.

6.2.1 Units. Coefficients of retroreflection R_A shall be specified in units of candelas per foot candle per square foot (candelas per lux per square meter).

6.2.2 R_A measurements at 0.2° observation angle and -4° entrance angle (0° rotation) shall be made on the same area of sheeting before and after application of the colored overlay film.

6.2.3 The ratio of the R_A (color) to R_A (White) shall be calculated and converted to a percentage to determine the film transmission values.

6.3 Specular Gloss. The electronic cuttable film shall have an 85° specular gloss of not less than 50 when tested in accordance with ASTM D 523.

6.4 Processing and Cuttability. The electronic cuttable film shall permit cutting, weeding, masking with transfer tape, lifting, and application to retroreflective sheeting when used in accordance with manufacturer's recommendations at temperatures between 65° and 95° (18.3° and 35.0° C) and relative humidity between 30% and 70%. The film shall lay flat with minimal edge curl and be dimensionally stable.

- 6.5 Adhesive Liner. The protective lay flat liner shall be a synthetic film liner resistant to moisture absorption and curl and shall be removable by peeling, without breaking, tearing, or removing any adhesive from the electronic cuttable film. The liner shall have a controlled release from the adhesive coated film sufficient to allow cutting and weeding without the film popping off from the liner, while still allowing the liner to easily be peeled from the film during application. The liner shall be printed with an indelible mark indicating the name of the film manufacturer.
- 6.5.1 Film with punched edges for use on sprocket fed knife over roll cutters shall be edge scored and weeded to remove film in the punched area as a means of eliminating adhesive build up on the sprockets.
- 6.6 Resistance to Accelerated Outdoor Weathering. When electronic cuttable film is applied to retroreflective sheeting, the surface of the film shall be weather resistant and show no appreciable cracking, blistering, crazing, or dimensional change after 3 years unprotected outdoor exposure, facing the equator and inclined 45° from the vertical (one year for orange EC film.) Following weather exposure, panels shall be washed in a 5% HCl solution for 45 seconds, rinsed thoroughly with clean water, blotted dry with a soft, clean cloth and brought to equilibrium at standard conditions. After cleaning, the coefficient of retroreflection shall not be less than the value specified by the using agency for colored retroreflective sheeting.
- 6.6.1 Show no appreciable evidence of cracking, scaling, pitting, blistering, edge lifting or curling or more than 1/32-inch (0.08 cm) shrinkage or expansion.
- 6.6.2 Show "good" color fastness or better when tested as in 5.7.
- 6.6.3 Retained reflectivity shall be the same as the using agency specification for colored retroreflective sheeting of the type being tested.
- 6.6.4 The electronic cuttable film shall not be removable from the retroreflective sheeting without damage.

Retroreflective performance measurements made after weather exposure shall be made only at angles of 0.2° observation and -4° entrance. Where more than one panel of a color is measured, the coefficient of retroreflection shall be the average of all determinations.

- 6.7 Colorfastness. One specimen, exposed and prepared as specified in 5.6 shall be wet out with a mild detergent and water solution and compared with a similarly treated unexposed specimen under natural (North sky) daylight or artificial daylight having a color temperature of 7600° K. The colorfastness shall be evaluated as follows:
- Excellent - no perceptible change in color.
 - Good - perceptible but no appreciable change in color.
 - Fair - appreciable change in color.

Appreciable change in color means a change that is immediately noticeable in comparing the exposed specimen with the original comparison specimen. If closer inspection or a change of angle of light is required to make apparent a slight change in color, the change is not appreciable.

6.8 General Characteristics and Packaging.

6.8.1 Roll Goods. When supplied as roll goods, the electronic cuttable film shall be of good appearance, free from ragged edges, cracks and extraneous materials. The maximum number of splices in each roll shall be three per 50 yards of material. Splices shall be butted. The sheeting shall be packed snugly in corrugated fiberboard cartons, in accordance with commercially accepted standards. Each carton shall clearly stipulate the brand, quantity, size, lot or run number, and color. Stored under normal conditions, the electronic cuttable film as furnished shall be suitable for use for a minimum period of one year.

6.8.2 Sign Faces. When supplied as a finished sign face or mounted sign, the sign face, made of electronic cuttable film and retroreflective sheeting, shall comply with the appearance, specification, and good workmanship designated by the using agency for sign faces constructed of colored retroreflective sheeting of the same type.

7.0 Performance Requirements and Obligations.

7.1 Certification. The film manufacturer shall, upon request, submit with each lot or shipment a certification which states that the material supplied will meet all of the requirements listed herein.

7.2 Field Performance Requirements. The electronic cuttable film applied to retroreflective sheeting, both materials applied in accordance with the manufacturer's recommendations, shall as a composite perform with the same effective performance life as the using agency specifies for that type of colored retroreflective sheeting. The composite sign will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign 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 minimums specified by the using agency for colored retroreflective sheeting.

7.3 Electronic Film Manufacturer's Replacement Obligation. Where it can be shown that retroreflective traffic signs with electronic cuttable film supplied and used according to the film manufacturer's recommendations have not met the performance requirements of Section 7.2, the film manufacturer shall cover restoration costs as provided in the using agency specification for colored retroreflective sheeting.

7.4 Government Using Agency Obligation. The using agency shall be responsible for requiring dating of all signs at the time of application. That date constitutes the start of the field performance obligation period.

8.0 Technical Assistance Requirements

8.1 Instruction and Training. The manufacturer supplying the electronic cuttable film requirement shall provide the services of a qualified technician for instruction and training at the primary sign manufacturing facility designated by the agency. This instruction shall be available on a quarterly basis at no additional cost, and shall include but not be limited to, training films, material

application, equipment operation, packaging, storage, and other proven sign shop practices as they apply to the electronic cuttable film supplied by the manufacturer, and to assure that the resulting signs can comply with the applicable specifications. Additional on-site technical assistance by the manufacturer supplying the electronic cuttable film shall be provided at each of the sign shops designated in the bid invitation. This assistance will be provided at least once each quarter of sign production, if required.

8.2 Equipment. The manufacturer supplying the electronic cuttable film requirement shall provide service for film cutting or application equipment of their manufacture, certify that trained personnel will be available on 72 hours notice to render such service, and shall stock authorized parts for their sheeting application equipment. The manufacturer supplying the electronic cuttable film requirement shall not be required to provide service on film cutting or application equipment not of their manufacture.

8.3 Compliance. Failure to comply with the requirements and schedules of 8.1 and 8.2 shall be cause for cancellation of contract.

9.0 Patented Devices, Materials, and Processes.

Seller will pay any damages, costs or fines resulting from any claims against City of Detroit (government unit) for infringement of third-party patents by product supplied by Seller under this specification. The costs paid by Seller shall include legal and court costs deemed reasonably necessary by counsel for City of Detroit (government unit) in defending against such claims.

ATTACHMENT # 5

***SPECIFICATION FOR
PROTECTIVE OVERLAY FILM***

City of Detroit
Specification for Anti-Graffiti Protective Overlay Film

PREMIUM PROTECTIVE OVERLAY FILM

1.0 Scope

This specification covers premium transparent protective overlay film designed for application to sign faces reflectorized with retroreflective sheeting to provide a superior barrier to staining by graffiti and other markings.

2.0 Description

The protective overlay film shall be a clear, non-chlorinated, colorless film which may be used in lieu of clear coating. It shall be durable, solvent resistant and shall be coated with a transparent, UV stabilized pressure sensitive adhesive protected by an easily removable paper liner.

3.0 Compatibility

The protective overlay film shall be compatible with reflective sheeting and inks used for signing. This compatibility shall be clearly designated by the manufacturers of each component or, alternately, each component shall be produced by a single manufacturer.

4.0 Performance Requirements

4.1 Tensile Strength. A 1" (25mm) wide sample of protective overlay film, with the liner removed shall have a minimum tensile strength of 4500 psi when tested at 72°F (23°C) using a jaw speed of 5 inches per minute.

4.2 Dimensional Stability. The protective overlay film, without adhesive, shall have a minimum melting point of 520°F (270°C).

4.3 Color. When protective overlay film is applied in accordance with the manufacturer's recommendation over retroreflective sheeting, the color of the film/sheeting composite shall conform to the color requirements of the screen processed colors for the type of sheeting material used.

4.4 Transparency. The overlay film, without adhesive, shall provide a minimum of 95% transmittance of light in the visible range (400 - 700 nanometers.) The overlay film shall remain transparent through the expected life of the sheeting to which it is applied.

- 4.5 Solvent Resistance. The protective overlay film, without adhesive shall show no swelling or crazing after immersion in any of the following solvents for 7 days:
1. Methylene Chloride
 2. Toluene
 3. Ethyl Acetate
 4. Gasoline
 5. Mineral Spirits
 6. Naphtha
- 4.6 Cleanability. The overlay film manufacturer shall identify acceptable cleaning systems sufficient to clean paint and other surface contaminants without damaging the sign face.
- 4.7 Field Performance. The expected performance life of a sign face constructed of overlay film and reflective sheeting shall be equivalent to the expected performance life of the retroreflective material used.
- 4.8 Storage. The overlay film, when stored in accordance with the manufacturers recommendations shall be suitable for use up to 1 year from date of Purchase.

Attachment # 6

Testing and Certification Requirements

ACCEPTANCE CRITERIA FOR RETROREFLECTIVE SHEETING/PERMANENT SIGNING

A. The Michigan Department of Transportation (MDOT) specification requirements for permanent signing require high intensity prismatic (MDOT 1996 Standard Specifications for Construction, Section 919.02.C).

B. National Transportation Product Evaluation Program (NTPEP) Testing Requirements

MDOT requires that all materials be tested by the NTPEP and meet the criteria listed below prior to any consideration being given regarding sign fabrication and field testing. NTPEP testing is a requirement for all new suppliers or for suppliers attempting to re-qualify product that was removed from the Qualified Products List. There will be no exception. All sheeting and ink colors used for permanent signing must be tested (typically white, yellow, red, green, blue and brown). The NTPEP test deck from Minnesota will be the basis for outdoor weathering review.

1. All sheeting samples must pass the ASTM D4956-90 and federal specification L-S-300C physical test requirements with a rating of "no effect."
2. After two years of weathering at 45 degrees, all sheeting samples will be reviewed for Loss of reflectivity and color change by comparing data with the initial coefficient of reflection and initial chromaticity color coordinates.
3. After two years of weathering at 45 degrees, all sheeting samples will be reviewed for loss of reflectivity and color change by comparing data with the initial coefficient of reflection and initial chromaticity color coordinates. Pass/fail determinations will be made on an individual basis, although samples must retain a minimum 90 percent reflectivity based on a control sample. Samples with chromaticity color coordinate changes will be determined a failure if the color fastness test is a rating less than "good".

C. Fabrication Requirements

The manufacturer must comply with steps 1, 2 and 3 listed below prior to sample submittal.

1. Manufacturers must provide documentation from an independent agency that shows successful fabrication and field performance of their sheeting.
2. Manufacturers must provide documentation that details performance life of sheeting (minimum of 80 percent reflectivity maintained at ten years)
3. All fabrication testing will be done by MDOT Maintenance Central Sign Shop. The manufacturer shall provide MDOT with the sheeting, ink and any necessary substrates. The inks shall not require clear coating. All sheeting and ink shall be manufactured by the company providing the materials for testing. All materials will remain the property of MDOT.
4. The manufacturing will supply MDOT with the following size sheeting samples.

1-12.75" x 50 yd. roll and 1- 36" x 25-yard roll of green sheeting, 1-48" x 25 yard roll of yellow sheeting; 1-24" x 50 yard roll of white sheeting; 1-24: x 50 yard roll of black sheeting; 1-24" x 50yrd roll of blue translucent film; 1-2" x 50 yard roll of white sheeting; 1-48" x 50 yard roll of slip sheeting; 1 gallon of black ink and 1 gallon of blue ink.

5. Testing will be done on standard MDOT signing substrates; .080 aluminum, aluminum extrusion, and plywood.
6. The MDOT Maintenance Central Sign Shop will report any significant fabrication problems to the Materials Section and a determination will be made whether to proceed with the field test.

D. Field Test Requirements

Field tests are necessary for initial placement on the Qualified Products List. (QPL) and for reinstatement of a product that has been removed from the QPL.

Field Test Parameters:

1. The MDOT shall choose the location of the test site.
2. The signs shall be fabricated by MDOT personnel in the presence of the manufacturer and shall be identified as experimental with a tag on the back of the sign. Sign substrates shall consist of .081 aluminum, aluminum extrusion, and plywood.
3. Signs will be reviewed by MDOT personnel. All reviews shall be documented with date, sign number, condition of sign, and any other pertinent data. Problems that will result in rejection of the product include, but are not limited to wrinkling, topcoat splitting, peeling, loss of reflectivity, and color change.
4. The manufacturer will be notified in writing concerning the results of the field study. From the time of sign installation, two years may be taken by MDOT to conclude the field evaluation. Completion of a successful test indicates that the product will be approved for one year. At the end of the one-year period, continued approval will be based on successful fabrication and field performance in Michigan.

E. MDOT reserves the right to verify submitted test information or to modify acceptance criteria for retroreflective sheeting at any time.

Attachment # 7

Warranty for Retroreflective Sign Sheeting materials and accessories

Warranty for Retroreflective Sign Sheeting materials and accessories

Components

The vendor shall provide warranties for all components and materials intended for the sign making process and shall replace all defective materials and workmanship upon demand at no cost to the City. The City of Detroit reserves the right to collect compensation for liquidated damages arising out of defective work provided by the vendor.

Installed signs.

The vendor shall procure from the manufacturer and issue to the City a written warranty to ensure continual effectiveness of all components intended for the sign making process during the entire life span of the signage (10 years). The warranty will cover the cost of restoring the sign to its original effectiveness at no cost to the City of Detroit for all materials including signage, substrate, installation hardware, support structures and anchors and labor for sign fabrication and reinstallation in the field, in the event of failure of the pre-stenciled face sheeting due to defective manufacture and /or fabrication. The primary warranty will be for a period of seven (7) years and will cover comprehensive replacement of signs to their original form. The secondary warranty will cover only the cost of the replacement of sheeting required to restore the sign surface to its original effectiveness. The secondary warranty will cover years 8, 9 and 10.

The award of the bid will be governed by the demonstrated ability of the bidder to execute the warranty.

Replacements

All materials damaged in transit due to inadequate packaging and/or inadequate sign face protection afforded, will be the vendor's responsibility. The City will require replacement of all such signs under the conditions of warranty. Failure to respond promptly to such requests for replacements will be grounds for termination of the contract without compensation.