9940000 Retroreflective and Nonreflective Sheeting and Sign Panel Fabrication
COMMENTS FROM INTERNAL/INDUSTRY REVIEW

MaryJo Lewis
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Comment: (6-24-13) 994. 1.) Retroreflective and Nonreflective Sheeting and Sign Panel Fabrications 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 film overlays.
2.) 994-2.1 Materials: Retroreflective sheeting material will be classified in accordance with and meet the requirements of ASTM D4956. Overlay materials must include colored and colorless film overlays and vinyl. For both of these sections, we question what is meant by "vinyl?" Why is this distinct from overlay film? We do not understand what this is/why it is considered a separate category. Please define more clearly.
3.) 994-2.3.2 Retroreflective Intensity: The retroreflectivity of sheeting and sheeting systems must meet the minimum initial requirements as stated for 0.2 degree and 0.5 degree observation angles 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 will be used for in-service requirements. Purple sign sheeting materials must meet the retroreflectivity requirements as identified in the MUTCD. Rotational sensitivity shall be tested in accordance with AASHTO M268. Rotationally sensitive sheeting will be noted on the QPL. 3M strongly urges that 1.0 degree observation angles (with -4 and +30 entrance angles) be included for ASTM Type XI as specified in ASTM D4956, because these angles represent key performance differentiation for the Type XI.
4.) 994-2.3.3 Colorless Overlay Films: Colorless overlay film is allowed for the purpose of improving color retention. These films must be compatible with the sign sheeting system and not delaminate or discolor for the in-service life of the system. Colorless overlay films shall filter transmittance of electromagnetic radiation as follows: 325nm – 370nm – 0.1% or less. 400nm to 700nm – greater than 75% Questions and comments on this section include the following: • What test method is referenced? What is the sample preparation methodology? How are these values measured? • The numbers shown refer to amount of light being transmitted, not the amount of light being filtered. So the spec language should be, " . . .shall transmit electromagnetic radiation as follows" • Why are the values shown considered to be pertinent to the performance of a sign? What data are they based upon? • It should be noted that transmitting only 75% in the visible region means that initial reflectivity could be diminished by 25% from the start. • Rather than specifying the film we suggest specifying the resulting system/sign, as the rest of this 994 specification is trying to do. For example, the sign face with image and overlay film should meet the requirements as stated in 994-2.3.1, 994-2.3.2 and 994-2.3.4 Please see Appendix 1 for a more detailed discussion of overlay film specification.
5.) 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 must be applied in the optimum direction. 3M would support modifying FDOT 944-3.5.2 to state that "When utilizing sheeting (for permanent signs) that is designated rotationally sensitive, fabricate signs by applying sheeting for cut-out legends, symbols, borders, and route marker attachments within the parent sign face in a uniform orientation, and apply all background sheeting in a uniform orientation." Applying sheeting designated as "rotationally sensitive" in the "optimum" direction

is not required, even according to the discussion and requirements of AASHTO M268. The AASHTO M268 standard only refers to applied copy on guide signs, not backgrounds, and specifically, not all other types of signs. The purpose of this requirement in M268 was to minimize any non-uniform appearance caused by random orientation of copy. Therefore, UNIFORM application (same as for the background sheeting defined in AASHTO M268) should be the only requirement, and only for applied copy. The relative difference in performance vis-à-vis the driver in most driving situations is minimal regardless of orientation. Where optimum orientation does provide value to the driver is when a sign needs to be viewed in an extreme entrance angle, such as a Keep Right sign. In this case, choosing to use the preferred orientation will enhance the wide entrance angularity performance of the sheeting. Please see attached Appendix 2 for a detailed discussion of "Optimum Rotation." The retroreflective sheeting for each sign 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. 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. The specific test and colorimeter for any measurement of Delta E needs to be more precisely defined, as there are several recognized ways to define and measure color difference (Delta E). Some of these have been deprecated by the color industry as not useful. Furthermore, the level of color difference that is visually noticeable or objectionable may vary significantly from one color to another. Delta E = 3 may be appropriate for some colors and not others. In addition, Delta E only refers to daytime (diffusely reflected) color and does not address nighttime (retroreflected) color.

Appendix 1. Discussion of UV Protective Overlay Film Specification Prior to determining a specification for an acceptable level of UV transmittance, details of test method and data treatment need to be clarified. Transmittance in the UV wavelength range: A specified value should represent the transmittance averaged over the wavelength range of 325-370 nm, which is not clearly defined in the proposed 994 specification. 3M analytical experts have cautioned that a value of 0.1% is at the accuracy limit of some common measurement instrumentation. Lab to lab correlation at this low level would be challenging. It is also a transmittance level that could be influenced by other factors in the test and measurement technique, such as lamination and choice of lamination substrate. A higher level (<1%) is likely to be adequate to provide UV screening. Transmittance in the Visible wavelength range: 3M suggests that transmission in the visible wavelength range can be ensured by requiring that the laminated construction (base retroreflective sheeting, image and applied overlaminate) meets the sheeting system brightness requirements per Specification 994. This approach appears to be in concert with the strategy outlined in the proposed revision of 994 now being commented upon. If a percent transmittance approach is selected, a higher minimum %T (>85%) in the visible range would help ensure that color and reflectivity are not negatively impacted.

Appendix 2. Discussion of Rotational Uniformity 3M believes the rotational uniformity definition within AASHTO M268-10 is defined arbitrarily and the concept of "optimal" rotation is misapplied with regard to sign construction when its effect upon the driver experience is considered. There are two possible interpretations of the driver need for rotational uniformity: 1) Uniformity of appearance 2) "optimal" performance 1) Uniformity of Appearance. The vast majority of retroreflective sheeting is used for the background of signs (and is used in a single,

fixed orientation on the sign). In fact, M268-10 section 3.3.2 requires background sheeting to be oriented uniformly (not in a preferred orientation). Therefore, all signs having text and graphics fabricated by screen printing, digital printing or electronically-cuttable film will not have uniformity concerns (and thus there is no need to specify an orientational uniformity requirement for sheeting in these applications). The most typical situation in which sheeting orientation may have any relevance on sign performance is when applied copy is cut out from a nested pattern on the sheeting. 3M would support modifying FDOT 944-3.5.2 to state that "When utilizing sheeting (for permanent signs) that does not meet the 20 percent maximum rotational requirement, fabricate signs by applying white sheeting for cut-out legends, symbols, borders, and route marker attachments within the parent sign face in a uniform orientation, and apply all background sheeting uniformly oriented." This meets the goal of desired uniform appearance and allows for the same flexibility in application that is afforded for background panels. 2) "Optimal" Performance As a result of the combination of multiple headlamp geometries (on vehicles of different sizes) there is no single "optimum" orientation that is relevant to all driving scenarios. "Optimum orientation" as selected by Ra at any limited group of angle combinations is misleading, as the luminance experienced by the driver (and thus, the sign's effectiveness) in most driving scenarios is not significantly affected by the sheeting orientation. Prismatic retroreflective sheeting sold by 3M is designed to perform under a wide range of viewing conditions in the field, including typical viewing conditions with small entrance angles, as well conditions where the sign is viewed at a high entrance angle, where retroreflective functionality has to be retained. The optical design of the sheeting allows a preferred orientation that provides good retroreflection for these high entrance angle scenarios. This is the concept of preferred or "specified" orientation (the feature of retroreflecting sufficiently at high entrance angles) as described in 3M's product literature. For example, Product Bulletin 3MTM Diamond GradeTM DG3 Reflective Sheeting Series 4000 states in part, ". . . it is possible to get the widest entrance angle light return when the sheeting is oriented in a particular manner. When high entrance angle (>50º) performance is required for given signs (e.g. Keep Right Symbols), it can be obtained easily by specifying the application orientation of the completed signs. In these situations the completed sign should have the sheeting positioned at the 0º orientation (downweb direction perpendicular to the road)." Note that this definition of preferred orientation actually has a functional effect for the driver, and is significantly different than the definition in AASHTO M-268. The photos below demonstrate how this preferred orientation provides good retroreflective performance specifically in regard to a very high entrance angle sign placement, through a sheeting-on-sheeting demonstration. In this case, a white sheeting designed with a preferred high-entrance-angle orientation serves as the background sheeting and a white "orientationally uniform" sheeting (without an orientation preferred for high entrance angle performance) is used as the copy. The photos below show the test signs in the scenario in daytime, the same signs in the scenario at night (using only low beam headlamps as illumination) and a view of the signs at a low-entrance-angle view at nighttime for comparison. Keep Right signs at a demonstration intersection close up of sign faces (white background and copy) The same Keep Right signs viewed at night, close up of sign faces viewed from sedan sedan, low beam VOA headlights low beam VOA headlights Low entrance angle view of signs at night As these photographs demonstrate, a sheeting with an orientation that is preferred for high entrance angle performance can be used to advantage for certain applications where a sign may need to be viewed at a high entrance angle. However, for entrance angles <30 degrees typical of most guide signs, any orientation will perform reasonably comparably when viewed by a driver in a moving vehicle. In small entrance angle geometries, a uniform sheeting orientation (where the background is uniform and the copy is uniform) may provide the preferred driver experience and economic sign

construction, as opposed to requiring sheeting to be placed in an "optimum" or specified orientation which is actually designed for extreme entrance angularity. In fact, our product literature states that ". . . signs and applied copy (letters, arrows, borders and shields) can be fabricated and installed using the application orientation that most efficiently utilizes the reflective sheeting." (See email with appendix)

Response:

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Comment: (7-2-13)
Why have we changed shall to must? Is there a different meaning in these two verbs? Most specifications use the verb shall.

Response:

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Paul Gentry
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Comment: (7-3-13) Text: 994-2.1 states that Retroreflective sheeting material will be classified in accordance with and meet the requirements of ASTM D4956. ASTM D4956 only makes reference to "base sheeting" and does not address anywhere the materials requirements of either inks, E.C. films or vinyl overlays. This needs to be addressed in some future Florida Method for testing. The color purple spelled out in the MUTCD 23 CFR 655 should refer to "Part 655 Table 1 to Appendix to Part 655, Subpart F". The above mentioned MUTCD 23 CFR 655 states that the Pantone specifications are not for use in sign fabrication. The second reference is a FHWA reference. Orange mesh signs mentioned in Specification 700 should be added to the statement in 994-2.3.4 Outdoor Weathering: Outdoor Weathering is not required for purple sheeting, Type VI fluorescent pink vinyl and fluorescent yellow vinyl signs and Type VI fluorescent orange mesh signs. The ASTM D4956 requirement of a successful 6 month outdoor weathering requirement cannot be met in Florida's climate due to our intense UV. Since this is a temporary material, it might be easier to get a manufacturer of the devices to apply for QPL inclusion if they know that this requirement is waived. At present, there are no vendors listed on the QPL for Fluorescent Orange mesh signs.

Response:

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Moe Madar
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Comment: (7-4-13)

1. 994-2.2 QPL: Why require an infrared identification curve? Products are already being weathered for quality and warrantied.

Response:

2. 944-2.3.3 Colorless Overlay Film: Why require spectrometer testing on colorless overlay? Again, this product is being weathered before QPL listing and warranted for use.

Response:

3. 944-2.3.4 Outdoor Weathering: Why not require durability testing for purple? This is meant to be a permanent color.

Response:

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Grier Kirkpatrick, 3M
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Comment: (7-2-13)

1. 994-1.1 and 994-2.1:

For both of these sections below, we question what is meant by "vinyl?" Why is this distinct from overlay film? We do not understand what this is/why it is considered a separate category. Please define more clearly.

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 film overlays ~~for traffic control devices~~.

994-*2*.1.2 ~~Classification~~*Materials*: Retroreflective sheeting material ~~Types III, IV, V, VI and XI sha~~*wi*ll be classified *in accordance with and meet the requirements of* ~~in accordance with~~ ASTM D4956. *Overlay materials must include colored and colorless 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.~~

Response:

2. 994-2.3.2:

3M **strongly urges** that 1.0 degree observation angles (with -4 and +30 entrance angles) be included for ASTM Type XI as specified in ASTM D4956, because these angles represent key performance differentiation for the Type XI.

994-*2*.3.2 Retroreflective Intensity: The retroreflectiv*ity*~~e~~ *of* sheeting *and sheeting systems* ~~shall~~*must* meet the minimum initial requirements as stated for 0.2 degree and 0.5 degree observation angles ~~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 ~~sha~~will be used for in-service requirements. Purple sign sheeting materials ~~shall~~must meet the retroreflectivity requirements as identified in the MUTCD.

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

Response:

3. 994-2.3.3 Colorless Overlay Films:

Questions and comments on this section include the following:

• What test method is referenced? What is the sample preparation methodology? How are these values measured?

• The numbers shown refer to amount of light being transmitted, not the amount of light being filtered. So the spec language should be, " . . .shall transmit electromagnetic radiation as follows"

• Why are the values shown considered to be pertinent to the performance of a sign? What data are they based upon?

• It should be noted that transmitting only 75% in the visible region means that initial reflectivity could be diminished by 25% from the start.

• Rather than specifying the film we suggest specifying the resulting system/sign, as the rest of this 994 specification is trying to do. For example, the sign face with image and overlay film should meet the requirements as stated in 994-2.3.1, 994-2.3.2 and 994-2.3.4

Prior to determining a specification for an acceptable level of UV transmittance, details of test method and data treatment need to be clarified.

Transmittance in the UV wavelength range: A specified value should represent the transmittance averaged over the wavelength range of 325-370 nm, which is not clearly defined in the proposed 994 specification. 3M analytical experts have cautioned that a value of 0.1% is at the accuracy limit of some common measurement instrumentation. Lab to lab correlation at this low level would be challenging. It is also a transmittance level that could be influenced by other factors in the test and measurement technique, such as lamination and choice of lamination substrate. A higher level (<1%) is likely to be adequate to provide UV screening.

Transmittance in the Visible wavelength range: 3M suggests that transmission in the visible wavelength range can be ensured by requiring that the laminated construction (base retroreflective sheeting, image and applied overlaminate) meets the sheeting system brightness requirements per Specification 994. This approach appears to be in concert with the strategy outlined in the proposed revision of 994 now being commented upon. If a percent transmittance approach is selected, a higher minimum %T (>85%) in the visible range would help ensure that color and reflectivity are not negatively impacted.

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. 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.~~

4. **994-3.5.2 (first paragraph)**

3M would support modifying FDOT 944-3.5.2 to state that "When utilizing sheeting (for permanent signs) that is designated rotationally sensitive, fabricate signs by applying sheeting for cut-out legends, symbols, borders, and route marker attachments within the parent sign face in a uniform orientation, and apply all background sheeting in a uniform orientation."

Applying sheeting designated as "rotationally sensitive" in the "optimum" direction is not required, even according to the discussion and requirements of AASHTO M268. The AASHTO M268 standard only refers to applied copy on guide signs, not backgrounds, and specifically, not all other types of signs. The purpose of this requirement in M268 was to minimize any non-uniform appearance caused by random orientation of copy. Therefore, **UNIFORM** application (same as for the background sheeting defined in AASHTO M268) should be the only requirement, and only for applied copy. The relative difference in performance vis-à-vis the driver in most driving situations is minimal regardless of orientation. Where optimum orientation does provide value to the driver is when a sign needs to be viewed in an **extreme entrance angle**, such as a Keep Right sign. In this case, choosing to use the preferred orientation will enhance the wide entrance angularity performance of the sheeting. Please see attached Appendix 2 for a detailed discussion of "Optimum Rotation."

believes the rotational uniformity definition within AASHTO M268-10 is defined arbitrarily and the concept of "optimal" rotation is misapplied with regard to sign construction when its effect upon the driver experience is considered.

There are two possible interpretations of the driver need for rotational uniformity:

1) Uniformity of Appearance.

The vast majority of retroreflective sheeting is used for the background of signs (and is used in a single, fixed orientation on the sign). In fact, M268-10 section 3.3.2 requires background sheeting to be **oriented uniformly** (not in a preferred orientation). Therefore, *all* signs having text and graphics fabricated by screen printing, digital printing or electronically-cuttable film will not have uniformity concerns (and thus there is no need to specify an orientational uniformity requirement for sheeting in these applications). The *most typical* situation in which sheeting orientation may have any relevance on sign performance is when applied copy is cut out from a nested pattern on the sheeting. 3M would support modifying FDOT 944-3.5.2 to state that "When utilizing sheeting (for permanent signs) that does not meet the 20 percent maximum rotational requirement, fabricate signs by applying white sheeting for cut-out legends, symbols, borders, and route marker attachments within the parent sign face in a uniform orientation, and apply all background sheeting uniformly oriented." This meets the goal of desired uniform appearance and allows for the same flexibility in application that is afforded for background panels.

2) "Optimal" Performance

As a result of the combination of multiple headlamp geometries (on vehicles of different sizes) there is no single "optimum" orientation that is relevant to all driving scenarios. "Optimum orientation" as selected by Ra at any limited group of angle combinations is misleading, as the luminance experienced by the driver (and thus, the sign's effectiveness) in most driving scenarios is not significantly affected by the sheeting orientation.

Prismatic retroreflective sheeting sold by 3M is designed to perform under a wide range of viewing conditions in the field, including typical viewing conditions with small entrance angles, as well conditions where the sign is viewed at a high entrance angle, where retroreflective functionality has to be retained. The optical design of the sheeting allows a preferred orientation that provides good retroreflection ***for these high entrance angle scenarios***. This is the concept of preferred or "specified" orientation (the feature of retroreflecting sufficiently at high entrance angles) as described in 3M's product literature. For example, Product Bulletin 3MTM Diamond GradeTM DG3 Reflective Sheeting Series 4000 states in part, ". . . it is possible to get the widest entrance angle light return when the sheeting is oriented in a particular manner. When high entrance angle (>50º) performance is required for given signs (e.g. Keep Right Symbols), it can be obtained easily by specifying the application orientation of the completed signs. In these situations the completed sign should have the sheeting positioned at the 0º orientation (downweb direction perpendicular to the road)." Note that this definition of preferred orientation actually has a functional effect for the driver, and is significantly different than the definition in AASHTO M-268.

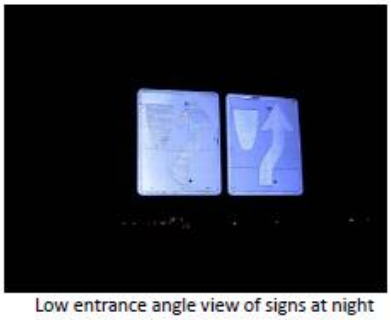
The photos below demonstrate how this preferred orientation provides good retroreflective performance specifically in regard to a very high entrance angle sign placement, through a sheeting-on-sheeting demonstration. In this case, a white sheeting designed with a preferred high-entrance-angle orientation serves as the background sheeting and a white "orientationally uniform" sheeting (without an orientation preferred for high entrance angle performance) is used as the copy. The photos below show the test signs in the scenario in daytime, the same signs in the scenario at night (using only low beam headlamps as illumination) and a view of the signs at a low-entrance-angle view at nighttime for comparison.

Keep Right signs at a demonstration intersection

close up of sign faces (white background and copy)

The same Keep Right signs viewed at night, sedan, low beam VOA headlights

close up of sign faces viewed from sedan low beam VOA headlights



Low entrance angle view of signs at night

As these photographs demonstrate, a sheeting with an orientation that is *preferred for high entrance angle performance* can be used to advantage for certain applications where a sign may need to be viewed at a high entrance angle. However, for entrance angles <30 degrees typical of most guide signs, any orientation will perform reasonably comparably when viewed by a driver in a moving vehicle. In small entrance angle geometries, a uniform sheeting orientation (where the background is uniform and the copy is uniform) may provide the preferred driver experience and economic sign construction, as opposed to requiring sheeting to be placed in an "optimum" or specified orientation which is actually designed for extreme entrance angularity. In fact, our product literature states that ". . . signs and applied copy (letters, arrows, borders and shields) can be fabricated and installed using the application orientation that most efficiently utilizes the reflective sheeting."

994-3.5.2Application 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~~must be applied in the optimum direction.*

Response:

5. 994-3.5.2 (second paragraph)

The specific test and colorimeter for any measurement of Delta E needs to be more precisely defined, as there are several recognized ways to define and measure color difference (Delta E). Some of these have been deprecated by the color industry as not useful. Furthermore, the level of color difference that is visually noticeable or objectionable may vary significantly from one color to another. Delta E = 3 may be appropriate for some colors and not others. In addition, Delta E only refers to daytime (diffusely reflected) color and does not address nighttime (retroreflected) color.

The retroreflective sheeting for each sign ~~sha~~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. 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.

Response:

Grier Kirkpatrick
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Comment: (7-26-13) **994-3.5.2 Application of Sheeting**
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.
3M's interpretation of this paragraph is that it applies to conventionally produced guide signs using
direct applied or demountable legends, etc. attached to the face of background sheeting.
In the case of an alternative method of guide sign production (EC film, digital imaging) the background
sheeting (in these cases, white sheeting) should be oriented uniformly as noted in this section.

Response:

Comment: (7-26-13) **994-2.3.3 Colorless Overlay Films:** Colorless overlay film is allowed for the purpose of
improving color retention. These films 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.
Understanding Florida's desire to characterize the films for future comparison, and if possible, to characterize UV protective qualities, 3M has concerns about the requested scanning according to ASTM D1003 Procedure B.
The transmittance scan according to this procedure is a luminous (ie, visible) transmittance weighted according to the luminosity function V(lambda) which is by definition zero below the visible wavelengths. This test is typically used to assess haze. It will not be a good assessment for UV protective qualities of the film, and when run on un-laminated overlay film samples is likely to be variable due to the scattering of the light from the adhesive, and thus not a good lot-to-lot comparison.
A spectral transmission test run in the wavelength range desired (325-700) would be preferred; however, it should be run on a laminated sample. Lamination completes the optics of an adhesive coated film (which will be different than on an un-laminated sample) . Alternately for materials characterization and future comparison, an IR scan could be used.

Response:

C. Matt Hills
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Comment: (7-26-13) In Section 994-2.2: The statement that Fluorescent Orange and Fluorescent Yellow-Green higher than Type IV will not be accepted, must be removed. This will eliminate many of the products that have been used in Florida for years, including all Avery Dennison FLO and FYG sheeting. I trust that this is not the intent of the state.

Response:

In Section 994-2.3.1: After the statement, "All sign sheeting systems consisting of inks and/or overlays will be tested as a system consisting of white base sheeting and each color of ink and/or overlay," additional requirements for inks and overlays need to be added, as ASTM does NOT cover these requirements. This can be solved by simply adding, "When inks and overlays are applied to white base sheeting, the combination must meet the color requirements and 70% of the reflectivity requirements of ASTM D 4956 for the base sheeting type used."

Response:

In Section 994-2.3.2: The reference to 23 CFR 655 Appendix 1, is not appropriate, as this is a color standard. I assume the state wants to align the retroreflective requirements for purple with the federal requirements, in which case the specification should say, "Purple sign sheeting material must meet the reflectivity requirements as identified in the MUTCD."

Please accept these comments, in addition to Moe Madar's comments. These comments are intended to create an effective specification that allows for consistent testing, application and QPL listing for all manufacturers. If you have any questions, please call me directly at the number below.

Response:

Moe Madar
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Comment: (7-26-13) **994-2.2 Qualified Products List (QPL):** All sheeting, process inks and overlay materials will be listed as a system on the Department's Qualified Products List (QPL). Sign sheeting systems will consist of base sheeting with ink and/or overlay materials. Products with an ASTM classification higher than Type IV will not be accepted for qualification on the QPL for fluorescent orange and fluorescent yellow-green (fluorescent colors are generally specified due to their conspicuity and requirements of higher visibility. Requiring an HIP grade (Type IV) sheeting for work-zones is fine because the signs are positioned so close to the road, where there is an abundant amount of headlight. But it is odd to require a fluorescent yellow-green type IV for school zones or pedestrian crossings, where the nature of the sign location generally requires high conspicuity and visibility. **This requirement combination is so unique that Avery does not even produce a Type IV fluorescent yellow-green sheeting. Avery only produces them in Types VIII, IX, & XI which are the industry standards.)** Manufacturers seeking evaluation of their products need to submit product data sheets, performance test reports from an independent laboratory showing the sign sheeting system meets the requirements of this Section, and a QPL application in accordance with Section 6. Information on the QPL application must include the individual materials comprising the sign sheeting system and identify colors, 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.

Response:

994-2.3.2 Retroreflective Intensity: The retroreflectivity of sheeting and sheeting systems (the industry standard for inking systems is 70% of initial values. This can be found on different manufacturer's product data bulletins, as well as many state specifications) must meet the minimum initial requirements as stated for all observation and entrance angles as indentified in ASTM D 4956. The 0.2 and 0.5 degree observation angles with an entrance angle of minus 4 degrees per ASTM D4956 will be used for in-service requirements. (The in-service values required by ASTM are 0.2 degree observation angle, and -4 and +30 entrance angle, not the 0.5 degree observation angle.) Purple sign sheeting materials must meet the retroreflectivity requirements as identified in the 23 CFR 655 Table 1 to Appendix to Part 655, Subpart F (CFR 655 Subpart F is a color spec. All purple requirements should reference MUTCD, where both color and retro are covered.)
Response:

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