EXHIBIT H

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MINNESOTA

3M COMPANY and 3M INNOVATIVE PROPERTIES COMPANY, Plaintiffs, v. AVERY DENNISON CORPORATION, Defendant.	CIVIL ACTION NO. 10-02630 (MJD/FLN) **DECLARATION OF MARK KLEINSCHMIT**

I, Mark Kleinschmit, under penalty of perjury, do hereby state as follows:

1. I have personal knowledge of the facts set forth herein and am competent to testify to the same.

2. I am providing this declaration in support of Avery Dennison Corporation's ("Avery") Opposition to 3M Company and 3M Innovative Properties Company's (collectively, "3M") Motion for a Preliminary Injunction.

3. I am currently employed at Avery as the Senior Technology Manager, Research and Development. I have held this position for over two years. As Senior Technology Manager, I am responsible for product development and process improvements for retroreflective sheeting and other light management films.

4. For several years, on behalf of Avery, I have been involved with an organization known as ASTM International ("ASTM"), formerly known as the American Society for Testing and Materials. ASTM is one of the largest standard setting organizations in the world, widely recognized for the quality and market relevance of its technical standards.

5. ASTM is made up of over 130 technical committees covering a vast array of industry areas, ranging from metals to the environment. One of the technical committees is the ASTM committee on "Road and Paving Materials," also referred to as "Main Committee D04" ("the Main Committee"). The Main Committee is responsible for the establishment and supervision of over 200 standards related to highway construction and maintenance, including road signs.

6. The Main Committee is broken up into several subcommittees, one of which is the subcommittee on "Highway Traffic Control Materials," also referred to as Subcommittee D04.38 ("the HTCM Subcommittee"). In turn, the HTCM Subcommittee is sometimes divided into smaller "task groups" focused on particular areas of highway construction. One of these task groups is the Retroreflective Sheeting Task Group ("the Retroreflective Task Group"). As its name implies, the Retroreflective Task Group focuses on standards related to retroreflective sheeting, such as the classification of sheeting into different "Types" according to performance.

7. One of the standards for which the HTCM Subcommittee and the Retroreflective Task Group are responsible is ASTM Specification No. D4956 ("Spec. No. D4956"), the "Standard Specification for Retroreflective Sheeting for Traffic Control." As the specification itself explains, Spec. No. D4956 covers "microprismatic, retroreflective sheeting designed for use on traffic control signs, delineators, barricades, and other devices." In my experience, Spec. No. D4956 is the standard used by most, federal, state, and local agencies in their specifications for various highway products that use retroreflective sheeting. A true and correct copy of the current version of Spec. No. D4956 is attached hereto as Exhibit 1.

8. Spec. No. D4956 is broken down into eleven different "types" of sheeting ranging in levels of brightness at different observation and entrance angles. Spec. No. D4956 describes

these varying levels of brightness in tabular format. By way of example, the table for Type VIII sheeting is reproduced below.

TABLE 8 Type VIII Sheeting[A]

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1°[B]	−4°	1000	750	375	100	150	45	30	800	600	300
0.1°[B]	+30°	460	345	175	46	69	21	14	370	280	135
0.2°	−4°	700	525	265	70	105	32	21	560	420	210
0.2°	+30°	325	245	120	33	49	15	10	260	200	95
0.5°	−4°	250	190	94	25	38	11	7.5	200	150	75
0.5°	+30°	115	86	43	12	17	5.0	3.5	92	69	35

[A] Minimum Coefficient of Retroreflection (R_A) cd/fc/ft^2(cd·lx^{-1}·m^{-2}).
[B] Values for 0.1° observation angle are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

9. 3M first introduced the idea for the addition of a new Type XI sheeting to Spec. No. D4956 around 2004. 3M proposed the idea at a December 8, 2004 ASTM meeting in Washington, D.C. At the time, 3M was the only manufacturer producing Type XI sheeting. Around the same time, I became aware that 3M had filed several patent applications related to the new Type XI standard that 3M was seeking to add to Spec. No. D4956.

10. On October 17, 2005, the HTCM Subcommittee issued a formal ballot on 3M's proposal. The ballot resulted in several "no" votes. Pursuant to ASTM voting procedures, each "no" vote was accompanied by a written statement called a "Negative."

11. The Negative of Jim Roth from the Ohio Department of Transportation ("DOT") explained:

> I am voting negative on this ballot issue, since I am not convinced that the creation of a new type is justified. The impetus for the establishment of Type XI is based on the argument that the 3M company needs a method to identify their new DG3 material for marketing purposes. To establish a new type on this basis will result in a type with only one product conforming to the type. This is a bad idea, because it can create the illusion of a competitive environment to the casual user of the specification, when in reality, a proprietary condition exists. The only real beneficiary of this type of arrangement is for the company producing the proprietary product. I think we can do better than this.

A true and correct copy of the Ohio DOT's Negative is attached hereto as Exhibit 2.

12. The Negative of Drew Buoni of Avery stated:

> Many members on this Sub-Committee may not realize it, but the product (DG3) outlined by the current ASTM ballot is a heavily patented and proprietary product. 3M Company has filed and received many patents on this product. As such, ***adopting the current Type 11 proposal will result in a proprietary and monopolistic position for 3M.*** Consider the following claims in a recent 3M patent application (Reference US 20040174601A1), which is just one of many 3M patents on their DG3 product.
>
> > Claim 41: Retroreflective sheeting comprising an array of preferred geometry cube corner elements that exhibits an average brightness at 0° and 90° orientation according to ASTM D-4956-01a of at least 375 cd/lx/m2 for an entrance angle of -4° and an observation angle of 0.5°.
> >
> > Claim 42: The retroreflective sheeting of Claim 41 wherein the average brightness is at least 400cd/lx/m2.

A true and correct copy of Avery's Negative is attached hereto as Exhibit 3.

13. On March 25, 2006, Avery circulated a PowerPoint presentation to some of the other members of the HTCM Subcommittee. In that presentation, Avery warned of the dangers of adopting a new standard that was covered by 3M's pending patent applications, specifically the '983 application. For example, Avery explained:

> In [the '983 application], 3M has gone beyond the patenting design or manufacturing, they have patented standardized testing performance!
>
> Notice, that in order to meet their proposed [Type XI] specification – you MUST violate this patent. Granting the specification allows ONLY their product – any other products would be in violation and thrown into court!
>
> Again – this kind of patent turns the [Type XI] specification into a law-suit trap!

A true and correct copy of Avery's March 25, 2006 PowerPoint presentation and cover email is attached hereto as Exhibit 4.

14. On March 27-28, some of the HTCM Subcommittee members held two teleconferences to address the Negatives. After the teleconference on March 27, 2006, Tom Bliss of 3M circulated an email explaining that the claims from the '983 application covering ASTM performance standards had been withdrawn. He explained that "[n]o patent claims contained in the application have been granted to date." He also attached an Office Action Summary from the United States Patent Office confirming that certain claims had been withdrawn. A true and correct copy of Tom Bliss' March 27, 2006 email is attached hereto as Exhibit 5.

15. During the March 28, 2006 teleconference, Tom Bliss once again confirmed that the patent claims related to ASTM performance standards had been withdrawn. The meeting minutes from the March 28, 2006 teleconference state:

> Tom Bliss said he spoke with their patent attorney on March 27th. The claims regarding the retroreflectivity at ASTM specific geometries have been withdrawn, although he is not sure what the final patent will look like (takes time to go through the process). The world patent claim has been withdrawn as well, but hasn't been addressed by the patent office at this time.

A true and correct copy of the March 27-28, 2006 meeting minutes and cover email is attached hereto as Exhibit 6.

16. On May 30, 2006, the HTCM Subcommittee issued a formal ballot to address each of the pending Negatives. On or about October 4, 2006, the HTCM Subcommittee chair, Jim Roth, sent a letter to the Main Committee attaching the ballot item, the Negatives, and 3M's formal responses. In response to the Negatives concerning 3M's patent applications, Tom Bliss once again responded "[t]he intellectual property claims at issue (those that relate to the ASTM performance standards) have been withdrawn from consideration before the U.S. Patent and

Trademark Office." A true and correct copy of Jim Roth's letter forwarding the ballot item, the Negatives, and 3M's responses is attached hereto as Exhibit 7.

17. On August 1, 2009, the ASTM formally adopted 3M's proposal for the addition of a new Type XI standard to Spec. No. D4956.

18. To the best of my knowledge, prior to the adoption of the new Type XI standard, 3M never informed Avery that it had revived its patent claims relating to ASTM performance standards. Nor did 3M ever inform Avery that any patents relating to ASTM performance standards had issued.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge, information, and belief.

September 9, 2010

3M Company and 3M Innovative Properties Company v. Avery Dennison Corporation
Civil Action No. 10-cv-02630-MJD-FLN

EXHIBIT 1

Designation: D4956 – 09$^{\varepsilon 1}$

Standard Specification for Retroreflective Sheeting for Traffic Control[1]

This standard is issued under the fixed designation D4956; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

ε^1 NOTE—Table 13 was editorially corrected in December 2009.

1. Scope

1.1 This specification covers flexible, non-exposed glass bead lens and microprismatic, retroreflective sheeting designed for use on traffic control signs, delineators, barricades, and other devices.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 The following safety hazards caveat pertains only to the test methods portion, Section 7, of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate

B209M Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

B449 Specification for Chromates on Aluminum

E284 Terminology of Appearance

E308 Practice for Computing the Colors of Objects by Using the CIE System

E808 Practice for Describing Retroreflection

E810 Test Method for Coefficient of Retroreflection of Retroreflective Sheeting Utilizing the Coplanar Geometry

E811 Practice for Measuring Colorimetric Characteristics of Retroreflectors Under Nighttime Conditions

E991 Practice for Color Measurement of Fluorescent Specimens Using the One-Monochromator Method

E1164 Practice for Obtaining Spectrometric Data for Object-Color Evaluation

E1247 Practice for Detecting Fluorescence in Object-Color Specimens by Spectrophotometry

E1347 Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry

E1349 Test Method for Reflectance Factor and Color by Spectrophotometry Using Bidirectional (45°:0° or 0°:45°) Geometry

E2152 Practice for Computing the Colors of Fluorescent Objects from Bispectral Photometric Data

E2153 Practice for Obtaining Bispectral Photometric Data for Evaluation of Fluorescent Color

E2301 Test Method for Daytime Colorimetric Properties of Fluorescent Retroreflective Sheeting and Marking Materials for High Visibility Traffic Control and Personal Safety Applications Using 45°:Normal Geometry

G7 Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials

G147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests

G151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

G152 Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

3. Terminology

3.1 *Definitions*—Definitions of terms are as described in Terminology E284 and Practice E808.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *reboundable sheeting, n*—retroreflective material intended to be attached to flexible impact resistant plastic devices, such as traffic drum-like channelizing devices.

4. Classification

4.1 Retroreflective sheeting shall consist of a white or colored sheeting having a smooth outer surface and that essentially has the property of a retroreflector over its entire

[1] This specification is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.38 on Highway Traffic Control Materials.

Current edition approved Aug. 1, 2009. Published August 2009. Originally approved in 1989. Last previous edition approved in 2007 as D4956 – 07 $^{\varepsilon 1}$. DOI: 10.1520/D4956-09.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

surface. There are nine types and five classes of retroreflective sheeting. Types are determined by conformance to the retroreflectance, color, and durability requirements listed in 6.1 and may be of any construction providing that those requirements are met. Type designation is provided as a means for differentiating functional performance. Typical examples of applications are provided for descriptive information only and are not intended to be limitations or recommendations. Common identifiers for each type are listed in 4.2.

4.1.1 The typical applications for the retroreflective sheeting addressed in this specification are:

Type	Typical Application
I	Highway signing, construction-zone devices, and delineators
II	Highway signing, construction-zone devices, and delineators
III	Highway signing, construction-zone devices, and delineators
IV	Highway signing, construction-zone devices, and delineators
V	Delineators
VI	Temporary roll-up signs, warning signs, traffic cone collars, and post bands
VII	This type designation has been replaced with Type VIII
VIII	Highway signing, construction-zone devices, and delineators
IX	Highway signing, construction-zone devices, and delineators
X	This type designation has been replaced with Type VIII
XI	Highway signing, construction-zone devices, and delineators

4.2 Retroreflective sheeting shall be classified as follows (the type sequence is not indicative of performance level):

4.2.1 *Type I*—A retroreflective sheeting referred to as "engineering grade" that is typically an enclosed lens glass-bead sheeting. Applications for this material include permanent highway signing, construction zone devices, and delineators.

4.2.2 *Type II*—A retroreflective sheeting referred to as "super engineer grade" that is typically an enclosed lens glass-bead sheeting. Applications for this material include permanent highway signing, construction zone devices, and delineators.

4.2.3 *Type III*—A retroreflective sheeting referred to as "high-intensity" that is typically manufactured as an encapsulated glass-bead retroreflective material or as an unmetalized microprismatic retroreflective element material. Applications for this material include permanent highway signing, construction zone devices, and delineators.

4.2.4 *Type IV*—A retroreflective sheeting referred to as "high-intensity" that is typically an unmetalized microprismatic retroreflective element material. Applications for this material include permanent highway signing, construction zone devices, and delineators.

4.2.5 *Type V*—A retroreflective sheeting referred to as "super high-intensity" that is typically a metalized microprismatic retroreflective element material. This sheeting is typically used for delineators.

4.2.6 *Type VI*—An elastomeric retroreflective sheeting without adhesive. This sheeting is typically a vinyl microprismatic retroreflective material. Applications include orange temporary roll-up warning signs, traffic cone collars, and post bands.

4.2.7 *Type VII*—Retroreflective sheeting materials previously classified as Type VII have been reclassified as Type VIII. The use of a designation as Type VII has been discontinued.

4.2.8 *Type VIII*—A retroreflective sheeting typically manufactured as an unmetalized cube corner microprismatic retroreflective element material. Applications for this material include permanent highway signing, construction zone devices, and delineators.

4.2.9 *Type IX*—A retroreflective sheeting typically manufactured as an unmetalized cube corner microprismatic retroreflective element material. Applications for this material include permanent highway signing, construction zone devices, and delineators.

4.2.10 *Type X*—Retroreflective sheeting materials previously classified as Type X have been reclassified as Type VIII. The use of a designation as Type X has been discontinued.

4.2.11 *Type XI*—A retroreflective sheeting typically manufactured as an unmetalized cube corner microprismatic retroreflective element material. Applications for this material include permanent highway signing, construction zone devices, and delineators.

NOTE 1—All retroreflective sheetings, but especially microprismatic sheetings, may have unique performance characteristics outside of the range of the standard geometries presented in the tables that define the types. Certain applications may require the use of a particular product within a particular type in order to achieve a desired level of retroreflectivity in a given situation. In these cases, information concerning additional performance characteristics must be obtained.

4.3 *Backing Classes*—The backing required for retroreflective sheeting shall be classified as follows:

4.3.1 *Class 1*—The adhesive backing shall be pressure-sensitive, require no heat, solvent, or other preparation for adhesion to smooth, clean surfaces.

4.3.2 *Class 2*—The adhesive backing shall have an adhesive that shall be activated by applying heat and pressure to the material. The temperature necessary to form a durable permanent bond shall be a minimum of 150°F (66°C).

4.3.2.1 The Class 2 material shall be repositionable under normal shop conditions and at substrate temperatures up to 100°F (38°C) and without damage to the material. The Class 2 material may be perforated to facilitate removal of air in heat-vacuum laminators, but the perforations must be of a size and frequency such that they do not cause objectionable blemishes when the sheeting is printed.

4.3.3 *Class 3*—The adhesive backing shall have a positionable low-tack pressure-sensitive adhesive that requires no heat, solvent, or other preparation for adhesion to smooth, clean surfaces. It shall be repositionable up to a temperature of 100°F (38°C) without damage to the material.

4.3.4 *Class 4*—The adhesive backing shall have a low-temperature pressure-sensitive adhesive that permits sheeting applications at temperatures down to +20°F (−7°C) without the aid of heat, solvent, or other preparation for adhesion to smooth, dry, clean surfaces.

4.3.5 *Class 5*—This shall be a nonadhesive backing made of material commercially used for self-supporting products such as traffic cone collars, temporary roll-up warning signs, and post bands.

5. Ordering Information

5.1 The purchaser using this specification shall include the following information:

5.1.1 ASTM designation (D4956),
5.1.2 Classification type (see Section 4),
5.1.3 Adhesive class (see 4.3),
5.1.4 Daytime color (see 6.3),
5.1.5 Length and width of sheets (see 8.1),
5.1.6 Length and width of rolls (see 8.2),
5.1.7 Supplementary information, if required by the purchaser, including:
5.1.7.1 Compliance with the minimum coefficient of retroreflection for 0.1° observation angle is a supplementary requirement which shall apply only when specified. An observation angle of 0.1° may be specified where the long distance performance of a sheeting is to be a requirement,
5.1.7.2 Fungus-resistance testing requirements (see Supplementary Requirement S1), and
5.1.7.3 Reboundable sheeting requirements (see Supplementary Requirement S2),
5.1.8 Indication that the sheeting is intended for work zone use, if applicable, to determine which weathering requirements apply, and
5.1.9 Any additional information.

6. Performance Requirements

6.1 This is a summary of the minimum performance requirements for each type of retroreflective sheeting.
6.1.1 *Type I*—Minimum Coefficient of Retroreflection—Table 1; Outdoor Weathering—24 months, see 6.4; Daytime Luminance Factor—Table 2; Other requirements: When sheeting is specified for construction work zone applications, the outdoor weathering shall be 12 months.
6.1.2 *Type II*—Minimum Coefficient of Retroreflection—Table 3; Outdoor Weathering—36 months, see 6.4; Daytime Luminance Factor—Table 2; Other requirements: When sheeting is specified for construction work zone applications, the outdoor weathering shall be 12 months.
6.1.3 *Type III*—Minimum Coefficient of Retroreflection—Table 4; Outdoor Weathering—36 months, see 6.4; Daytime Luminance Factor—Table 2; Other requirements: When sheeting is specified for construction work zone applications, the outdoor weathering shall be 12 months.
6.1.4 *Type IV*—Minimum Coefficient of Retroreflection—Table 5; Outdoor Weathering—36 months, see 6.4; Daytime Luminance Factor—Table 2; Other requirements: When sheeting is specified for construction work zone applications, the outdoor weathering shall be 12 months.
6.1.5 *Type V*—Minimum Coefficient of Retroreflection—Table 6; Outdoor Weathering—36 months, see 6.4; Daytime Luminance Factor—Table 2; Other requirements: When sheeting is specified for construction work zone applications, the outdoor weathering shall be 12 months.

TABLE 1 Type I Sheeting[A]

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown
0.2°	−4°	70	50	25	9.0	14	4.0	1.0
0.2°	+30°	30	22	7.0	3.5	6.0	1.7	0.3
0.5°	−4°	30	25	13	4.5	7.5	2.0	0.3
0.5°	+30°	15	13	4.0	2.2	3.0	0.8	0.2

[A] Minimum Coefficient of Retroreflection (R_A) cd/fc/ft²(cd·lx⁻¹·m⁻²).

TABLE 2 Daytime Luminance Factor (Y %)[A]

Color	All except Type V		Type V	
	Minimum	Maximum	Minimum	Maximum
White	27	...	15	
Yellow	15	45	12	30
Orange	10	30	7.0	25
Green	3.0	12	2.5	11
Red	2.5	15	2.5	11
Blue	1.0	10	1.0	10
Brown	1.0	9.0	1.0	9.0
Fluorescent Yellow-Green	60			
Fluorescent Yellow	40			
Fluorescent Orange	20			

[A] The luminance factors shown for fluorescent colors consist of the sum of a reflectance luminance factor and fluorescence luminance factor. The luminance factor may be determined using a good approximation to Illuminant D65, requiring an instrument with an appropriately filtered light source, or by using a bispectral photometer conforming to Test Method E2301.

TABLE 3 Type II Sheeting[A]

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown
0.2°	−4°	140	100	60	30	30	10	5.0
0.2°	+30°	60	36	22	10	12	4.0	2.0
0.5°	−4°	50	33	20	9.0	10	3.0	2.0
0.5°	+30°	28	20	12	6.0	6.0	2.0	1.0

[A] Minimum Coefficient of Retroreflection (R_A) cd/fc/ft²(cd·lx⁻¹·m⁻²).

TABLE 4 Type III Sheeting[A]

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown
0.1°[B]	−4°	300	200	120	54	54	24	14
0.1°[B]	+30°	180	120	72	32	32	14	10
0.2°	−4°	250	170	100	45	45	20	12
0.2°	+30°	150	100	60	25	25	11	8.5
0.5°	−4°	95	62	30	15	15	7.5	5.0
0.5°	+30°	65	45	25	10	10	5.0	3.5

[A] Minimum Coefficient of Retroreflection (R_A) cd/fc/ft²(cd·lx⁻¹·m⁻²).
[B] Values for 0.1° observation angle are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

6.1.6 *Type VI*—Minimum Coefficient of Retroreflection—Table 7; Outdoor Weathering—6 months, see 6.4; Daytime Luminance Factor—Table 2.
6.1.7 *Type VII*—Retroreflective sheeting materials previously classified as Type VII have been reclassified as Type VIII.
6.1.8 *Type VIII*—Minimum Coefficient of Retroreflection—Table 8; Outdoor Weathering—36 months, see 6.4; Daytime Luminance Factor—Table 2; Other requirements: When sheeting is specified for construction work zone applications, the outdoor weathering shall be 12 months.
6.1.9 *Type IX*—Minimum Coefficient of Retroreflection—Table 9; Outdoor Weathering—36 months, see 6.4; Daytime Luminance Factor—Table 2; Other requirements: When sheeting is specified for construction work zone applications, the outdoor weathering shall be 12 months.
6.1.10 *Type X*—Retroreflective sheeting materials previously classified as Type X have been reclassified as Type VIII.

TABLE 5 Type IV Sheeting[A]

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1°[B]	–4°	500	380	200	70	90	42	25	400	300	150
0.1°[B]	+ 30°	240	175	94	32	42	20	12	185	140	70
0.2°	– 4°	360	270	145	50	65	30	18	290	220	105
0.2°	+ 30°	170	135	68	25	30	14	8.5	135	100	50
0.5°	–4°	150	110	60	21	27	13	7.5	120	90	45
0.5°	+ 30°	72	54	28	10	13	6	3.5	55	40	22

[A] Minimum Coefficient of Retroreflection (R_A) cd/fc/ft²(cd·lx⁻¹·m⁻²).
[B] Values for 0.1° observation angle are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

TABLE 6 Type V Sheeting[A]

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue
0.1°[B]	–4°	2000	1300	800	360	360	160
0.1°[B]	+ 30°	1100	740	440	200	200	88
0.2°	– 4°	700	470	280	120	120	56
0.2°	+ 30°	400	270	160	72	72	32
0.5°	–4°	160	110	64	28	28	13
0.5°	+ 30°	75	51	30	13	13	6.0

[A] Minimum Coefficient of Retroreflection (R_A) cd/fc/ft²(cd·lx⁻¹·m⁻²).
[B] Values for 0.1° observation angle are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

6.1.11 *Type XI*—Minimum Coefficient of Retroreflection—Table 10; Outdoor Weathering—36 months, see 6.4; Daytime Luminance Factor—Table 2; Other requirements: When sheeting is specified for construction work zone applications, the outdoor weathering shall be 12 months.

6.2 *Coefficient of Retroreflection*—The coefficient of retroreflection shall meet or exceed the minimum requirements for the appropriate type of sheeting (see Table 1 and Tables 3-10) as specified in 7.3.

6.3 *Daytime Color*—The color of the sheeting shall conform to requirements of Table 2 and Table 11 when tested in accordance with 7.4. Daytime color requirements were developed for a limited set of retroreflective sheetings and a limited set of measurement devices. Measurement techniques appropriate for a wider range of optical technologies and instruments are under development. Some sheeting may require visual assessment to determine the acceptability of daytime appearance.

6.4 *Accelerated Outdoor Weathering Requirements*—The retroreflective sheeting shall be weather resistant and show no appreciable cracking, scaling, pitting, blistering, edge lifting, or curling, or more than 1/32-in. (0.8-mm) shrinkage or expansion when tested in accordance with 7.6. Conduct retroreflectivity measurements after outdoor weathering at 0.2° observation and –4° and +30° entrance angles. The minimum coefficient of retroreflection (R_A) after weathering is specified in Table 12.

NOTE 2—Supplementary Requirement S3 describes a method for artificial accelerated weathering, which users of this specification may employ for preliminary judgment until outdoor weathering results are available.

6.5 *Colorfastness*—After the specified outdoor weathering, the specimen shall conform to the requirements of Table 2 and Table 11 when tested in accordance with 7.4 and 7.7.

6.6 *Shrinkage*—The retroreflective sheeting shall not shrink in any dimension more than 1/32 in. (0.8 mm) in 10 min or more than 1/8 in. (3.2 mm) in 24 h when tested in accordance with 7.8.

6.7 *Flexibility*—The sheeting shall be sufficiently flexible to show no cracking when tested in accordance with 7.9.

6.8 *Liner Removal*—The liner, when provided, shall be easily removed without soaking in water or other solutions, and shall not break, tear, or remove adhesive from the sheeting. (See 7.10.)

6.9 *Adhesion*—When tested in accordance with 7.5, the adhesive backing of the retroreflective sheeting shall produce a bond that will support a 1¾-lb (0.79-kg) weight for adhesive classes 1, 2, and 3 or a 1-lb (0.45-kg) weight for adhesive class 4 for 5 min, without the bond peeling for a distance of more than 2 in. (51 mm).

6.10 *Impact Resistance*—Retroreflective sheeting shall show no cracking or delamination outside of the actual area of impact when subjected to the impact test in accordance with 7.11.

6.11 *Nighttime Color*—The nighttime color of the sheeting shall conform to the requirements of Table 13, when tested in accordance with 7.12.

7. Test Methods

7.1 *Test Conditions*—Unless otherwise specified in this specification, condition all adhesively bonded and unbonded test samples and specimens at a temperature of 73 ± 3°F (23 ± 2°C) and 50 ± 5 % relative humidity for 24 h prior to testing.

7.2 *Panel Preparations*—Unless otherwise specified in this specification, when tests are to be performed using test panels, apply the specimens of retroreflective material to smooth aluminum cut from Alloy 6061-T6 or 5052-H38, in accordance with Specification B209 or B209M. The sheets shall be 0.020 in. (0.508 mm), 0.040 in. (1.016 mm), or 0.063 in. (1.600 mm) in thickness, and a minimum of 8 by 8 in. (200 by 200 mm). Prepare the aluminum in accordance with Specification B449, Class 2, or degrease and lightly acid etch before the specimens are applied. Apply the specimens to the panels in accordance with the recommendations of the retroreflective sheeting manufacturer.

7.3 *Coefficient of Retroreflection*:

7.3.1 For lots, rolls, or sheets of retroreflective sheeting at least 1 yd long in new (unexposed) condition, take 3 samples in accordance with Section 9.1. Determine the coefficients of retroreflection in accordance with Test Method E810.

TABLE 7 Type VI Sheeting[A]

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1°[B]	–4°	750	525	190	90	105	68	600	450	300
0.1°[B]	+ 30°	300	210	75	36	42	27	240	180	120
0.2°	– 4°	500	350	125	60	70	45	400	300	200
0.2°	+ 30°	200	140	50	24	28	18	160	120	80
0.5°	–4°	225	160	56	27	32	20	180	135	90
0.5°	+ 30°	85	60	21	10	12	7.7	68	51	34

[A] Minimum Coefficient of Retroreflection (R_A) cd/fc/ft^2(cd·lx^{-1}·m^{-2}).
[B] Values for 0.1° observation angle are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

TABLE 8 Type VIII Sheeting[A]

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1°[B]	– 4°	1000	750	375	100	150	45	30	800	600	300
0.1°[B]	+ 30°	460	345	175	46	69	21	14	370	280	135
0.2°	– 4°	700	525	265	70	105	32	21	560	420	210
0.2°	+ 30°	325	245	120	33	49	15	10	260	200	95
0.5°	– 4°	250	190	94	25	38	11	7.5	200	150	75
0.5°	+ 30°	115	86	43	12	17	5.0	3.5	92	69	35

[A] Minimum Coefficient of Retroreflection (R_A) cd/fc/ft^2(cd·lx^{-1}·m^{-2}).
[B] Values for 0.1° observation angle are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

TABLE 9 Type IX Sheeting[A]

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1°[B]	–4°	660	500	250	66	130	30	530	400	200
0.1°[B]	+ 30°	370	280	140	37	74	17	300	220	110
0.2°	– 4°	380	285	145	38	76	17	300	230	115
0.2°	+ 30°	215	162	82	22	43	10	170	130	65
0.5°	–4°	240	180	90	24	48	11	190	145	72
0.5°	+ 30°	135	100	50	14	27	6.0	110	81	41
1.0°	–4°	80	60	30	8.0	16	3.6	64	48	24
1.0°	+ 30°	45	34	17	4.5	9.0	2.0	36	27	14

[A] Minimum Coefficient of Retroreflection (R_A) cd/fc/ft^2(cd·lx^{-1}·m^{-2}).
[B] Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

TABLE 10 Type XI Sheeting[A]

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1°[B]	–4°	830	620	290	83	125	37	25	660	500	250
0.1°[B]	+30°	325	245	115	33	50	15	10	260	200	100
0.2°	–4°	580	435	200	58	87	26	17	460	350	175
0.2°	+30°	220	165	77	22	33	10	7.0	180	130	66
0.5°	–4°	420	315	150	42	63	19	13	340	250	125
0.5°	+30°	150	110	53	15	23	7.0	5.0	120	90	45
1.0°	–4°	120	90	42	12	18	5.0	4.0	96	72	36
1.0°	+30°	45	34	16	5.0	7.0	2.0	1.0	36	27	14

[A] Minimum Coefficient of Retroreflection (R_A) cd/fc/ft^2(cd·lx^{-1}·m^{-2}).
[B] Values for 0.1° observation angle are supplementary requirements that shall only apply when specified by the purchaser in the contract or order.

7.3.1.1 To conform to this specification, the average of the 3 coefficients of retroreflection shall meet the minimum limits given in Section 6.2 and none of the coefficients of retroreflection obtained on any of the samples shall be less than 80 % of the values required in Section 6.2.

7.4 *Daytime Color*:

7.4.1 Determine the chromaticity and luminance factor *Y(%)* for CIE standard illuminant D65 and the 1931 CIE 2° standard observer in accordance with Practice E308, Test Methods E1347, E1349, and E2301, and Practices E991, E1164, E2152, and E2153, as applicable. The luminance factor is the sum of the reflectance luminance factor and the fluorescence luminance factor. Bispectral measurement provides the individual factors, while measurement with simulated D65 provides their sum.

7.4.1.1 For fluorescent specimens, it is necessary either that the physical illumination of the specimen be a good approximation to illuminant D65, requiring an instrument with an appropriately filtered light source, or else that a bispectral photometer conforming to Test Method E2301 be used.

7.4.2 There are three types of 45/0 (0/45) instruments: annular, circumferential, and uniplanar (see Fig. 1). Measurement of prismatic sheeting with circumferential instruments

TABLE 11 Color Specification Limits (Daytime)[A]

Color	1		2		3		4	
	x	y	x	y	x	y	x	y
White	0.303	0.300	0.368	0.366	0.340	0.393	0.274	0.329
Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472
Orange	0.558	0.352	0.636	0.364	0.570	0.429	0.506	0.404
Green[B]	0.026	0.399	0.166	0.364	0.286	0.446	0.207	0.771
Red	0.648	0.351	0.735	0.265	0.629	0.281	0.565	0.346
Blue[B]	0.140	0.035	0.244	0.210	0.190	0.255	0.065	0.216
Brown	0.430	0.340	0.610	0.390	0.550	0.450	0.430	0.390
Fluorescent Yellow-Green	0.387	0.610	0.369	0.546	0.428	0.496	0.460	0.540
Fluorescent Yellow	0.479	0.520	0.446	0.483	0.512	0.421	0.557	0.442
Fluorescent Orange	0.583	0.416	0.535	0.400	0.595	0.351	0.645	0.355

[A] The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 Standard Colorimetric System measured with CIE Standard Illuminant D65.

[B] The saturation limit of green and blue may extend to the border of the CIE chromaticity locus for spectral colors.

TABLE 12 Outdoor Weathering Photometric Requirements for All Climates

Type	Months[A]	Minimum Coefficient of Retroreflection, R_A
I	24[B]	50 % of Table 1
II	36[B]	65 % of Table 3
III	36[B]	80 % of Table 4
IV	36[B]	80 % of Table 5
V	36[B]	80 % of Table 6
VI	6	50 % of Table 7
VIII	36[B]	80 % of Table 8
IX	36[B]	80 % of Table 9
XI	36[B]	80 % of Table 10

[A] Testing at shorter intervals may be done to gather additional information.

[B] When sheeting is specified for construction work zone applications, the outdoor weathering shall be 12 months.

may require multiple measurements. Measurement of prismatic sheeting with uniplanar instruments definitely requires multiple measurements.

7.4.2.1 If the measurement geometry is circumferential, then the testing laboratory must verify that the apertures in the ring are sufficiently close for acceptable approximation to an annular measurement. This may depend on the optical construction of the specimen, and must be determined by the testing laboratory. Multiple measurements of the same specimen area at different rotations may be averaged to improve the approximation to an annular measurement.

7.4.2.2 If the measurement geometry is uniplanar, then a sequence of measurements shall be made on the same specimen area at incremental rotations, and the measurement values shall be taken as averages over all the rotations. The number of rotations shall be large enough for acceptable approximation to an annular measurement. The number depends on the optical construction of the specimen and must be determined by the testing laboratory.

7.4.3 Instruments (spectrophotometers, colorimeters) used to measure daytime color shall have 45/0 or 0/45 illumination and viewing geometry. The referee instrument shall have 10° apertures for both illumination and viewing. Use of aperture sizes deviating from these may affect the measurement results.

7.5 *Adhesion*—Apply the sheeting to a test panel, 0.040 in. (1.016 mm) minimum thickness, prepared as specified in 7.2. Bond 4 in. (102 mm) of a 1 by 6-in. (25.4 by 152-mm) specimen to a test panel. Condition (see 7.1) and then attach the weight to the free end and allow it to hang free at an angle of 90° to the panel surface for 5 min.

7.6 *Outdoor Weathering*—Conduct outdoor exposures in accordance with Practice G7. During exposure, test panels shall be open backed and oriented at an angle of 45° from the horizontal and facing the equator in accordance with Practice G7. Expose two panels per location for the number of months specified in Table 12. Conduct exposures in locations with the climate types shown in Table 14. Panel labeling, and conditioning and handling of panels prior to exposure and during evaluation periods shall be in accordance with Practice G147.

7.6.1 *Specimen Mounting for Type VI Sheetings*—Clamp the ends of 4 by 12-in. (100 by 300-mm) specimens between 1 by 8 by 5⁄64-in. (25 by 200 by 2-mm) 6061-T6 aluminum bars, and attach these bars to mounting strips on the outdoor exposure rack. Expose the specimens so that the long axis is parallel to the ground so that bolts used to clamp specimen ends do not interfere with attachment to the test rack. Fig. 2 is a diagram showing the arrangement of the clamping bars and the test specimen.

7.6.2 *Washing Panels After Exposure*—Following exposure, gently wash the panels using a soft cloth or sponge and clean water or a dilute solution of a mild detergent (1 % by weight in water, maximum concentration). After washing, rinse thoroughly with clean water, and blot dry with a soft clean cloth. After washing and drying, condition the panels at room temperature for at least 2 h prior to conducting any property measurements.

7.6.3 *Measurement of Coefficient of Retroreflection*—After panels have been washed, dried, and conditioned in accordance with 7.6.2, measure retroreflectance at 0.2° observation and –4° and 30° entrance angles. Report the average of the coefficient of retroreflection measured at each geometry on the two panels from each exposure location.

NOTE 3—The use of two samples per weathering deck is considered a minimum and reflects historical practice and practicality. Additional samples may be weathered, and the results averaged, to decrease the effects of variability associated with the weathering process.

NOTE 4—Weathering tests are generally performed less frequently than other tests in this specification. Judgment must be used to satisfy the user that weathering results obtained on exposed samples are sufficiently applicable to the material being supplied.

7.7 *Colorfastness*—Use one of the outdoor weathered specimens to test for colorfastness. Wash, dry, and condition panels in accordance with 7.6.2 and test as specified in 7.4.

TABLE 13 Color Specification Limits (Nighttime)[A]

Color	1		2		3		4	
	x	y	x	y	x	y	x	y
White (no requirement)								
Yellow	0.513	0.487	0.500	0.470	0.545	0.425	0.572	0.425
Orange	0.595	0.405	0.565	0.405	0.613	0.355	0.643	0.355
Green	0.007	0.570	0.200	0.500	0.322	0.590	0.193	0.782
Red	0.650	0.348	0.620	0.348	0.712	0.255	0.735	0.265
Blue	0.033	0.370	0.180	0.370	0.230	0.240	0.091	0.133
Brown	0.595	0.405	0.540	0.405	0.570	0.365	0.643	0.355
Fluorescent Yellow-Green	0.480	0.520	0.473	0.490	0.523	0.440	0.550	0.449
Fluorescent Yellow	0.554	0.445	0.526	0.437	0.569	0.394	0.610	0.390
Fluorescent Orange	0.625	0.375	0.589	0.376	0.636	0.330	0.669	0.331

[A] The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 Standard Colorimetric System measured with CIE Standard Illuminant D65.

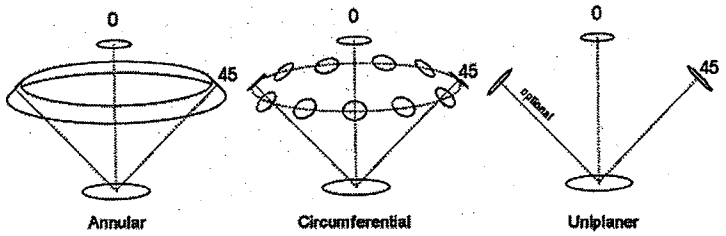

FIG. 1 Three Types of 0/45 (45/0) Instrument

TABLE 14 Climate Types for Use in Outdoor Exposures of Retroreflective Sheetings

Climate Type[A,B]	Mean Monthly Temperature, °F (°C)		Representative Example of a Typical Location
	Warmest Month	Coldest Month	
Tropical summer rain	82 to 93 (28 to 34)	64 to 72 (18 to 22)	Miami, FL
Desert	82 to 93 (28 to 34)	50 to 63 (10 to 17)	Phoenix, AZ
(optional, but recommended)	Climate mutually agreed upon between the purchaser and the seller[C]		

[A] Climate classification is in accordance with the Koppen reformed classification system.

[B] Outdoor exposure results from Miami, FL and Phoenix, AZ are recognized internationally as benchmarks for evaluating durability of many different types of material and products.

[C] Outdoor exposures of retroreflective sheeting materials are conducted in locations representative of several different climates by the National Transportation Product Evaluation Program (NTPEP) run by AASHTO.

7.8 *Shrinkage*—Condition a 9 by 9-in. (229 by 229-mm) retroreflective sheeting specimen with liner, a minimum of 1 h at standard test conditions (see 7.1). Remove the liner and place the specimen on a flat surface with the adhesive side up. Ten minutes after the liner is removed and again after 24 h, measure the specimen to determine the amount of dimensional change.

7.9 *Flexibility*—Bend the sheeting, in 1 second, around a ⅛-in. (3.2-mm) mandrel with adhesive contacting the mandrel. For ease of testing, spread talcum powder on the adhesive to prevent sticking to the mandrel. The test specimen shall be 2¾ by 11 in. (70 by 229 mm). The test temperature shall be 73 ± 3°F (23± 2°C).

7.10 *Liner Removal*—The protective liner, if any, shall be easily removed following accelerated storage for 4 h at 160°F (71°C) under a weight of 2.5 psi (17.2 kPa).

7.11 *Impact Resistance*—Apply the retroreflective sheeting to a 3 by 5 by 0.040-in. (76 by 127 by 1.016-mm) 6061-T6 aluminum test panel as specified in 7.2 and test condition as specified in 7.1. Subject the sheeting to the impact of a 2-lb (0.91-kg) weight, with a ⅝-in. (15.8-mm) diameter rounded tip, dropped from the height necessary to generate an impact of 10 in.-lb (1.13 N-m).

7.12 *Nighttime Color*—Test for nighttime color. Determine the chromaticity in accordance with Practice E811 and evaluated using the CIE system in Practice E308. (The saturation limit shall be considered to extend to the boundary of the chromaticity locus of spectral colors.) Measure using CIE Illuminant A, observation angle of 0.33 degrees, entrance angle of +5 degrees, source and receiver apertures not to exceed 10 minutes of arc, and CIE 1931 (2 degree) standard observer.

8. General Requirements

8.1 *Sheets*—When the retroreflective material is in sheet form, the design, dimension, and tolerances shall be as specified by the purchaser.

8.2 *Rolls*—When ordered in rolls, the retroreflective material shall be evenly wound on a core of sufficient rigidity to prevent distortion of the roll. The maximum number of splices shall be 4/50-yd (46-m) roll. Each splice shall be visible at the edge of the roll. The length and width will be specified by the purchaser.

8.3 *Color Processing*—The sheeting shall permit color processing with compatible transparent and opaque process

FIG. 2 Diagram Showing Clamping Bars Used for Attaching Type VI Sheeting Specimens to Test Rack for Outdoor Exposure

colors in accordance with the sheeting manufacturer's recommendation at temperatures between 60 to 100°F (16 to 38°C) and relative humidity at 20 to 80 %.

9. Sampling

9.1 To determine conformance to requirements for Coefficients of Retroreflection for rolls or sheets at least 1 yd (0.914 m) long of retroreflective sheeting in new (unexposed) condition:

9.1.1 A full width × 1 yd (0.914 m) long specimen is selected at random to represent the entire sheet, roll, or lot.

NOTE 5—Samples smaller than 1 yd (0.914 m) long should not be used to judge conformance for full rolls or lots.

9.1.2 Three samples are taken from the selected specimen.

9.1.2.1 The three samples shall be spaced evenly across (left, center, right) and spaced evenly down the specimen as shown in the examples in Fig. 3.

9.2 For determining conformance to all other requirements, single samples taken at random shall be tested.

10. Precision and Bias

10.1 The precision and bias for the test methods in Section 7 have not been determined.

11. Packaging and Package Marking

11.1 The sheets or rolls manufactured under this specification shall be packaged in accordance with commercially acceptable standards. Each package shall be marked with the following:

Name, Brand, or Trademark
Quantity
Size
Lot or Run Number
Part Number

12. Keywords

12.1 barricades; delineators; highway signing; reboundable sheeting; retroreflective sheeting; traffic control

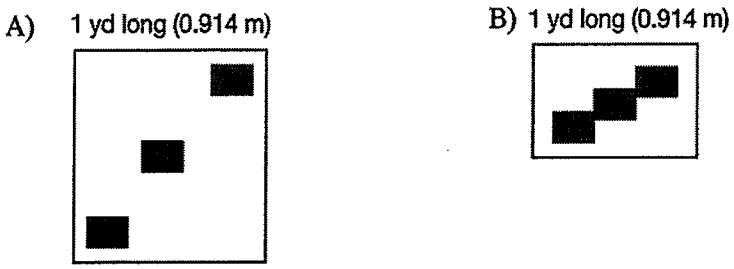

FIG. 3 Examples of Proper Spacing for Samples

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply only when specified by the purchaser in the contract or order.

S1. Fungus Resistance

S1.1 *Scope*—This supplementary specification covers fungus-resistance testing.

S1.2 *Test Requirements and Test Methods:*

S1.2.1 *Test Condition*—Unless otherwise specified in this specification, all adhesively bonded and unbonded test samples and specimens shall be conditioned at a temperature of 73 ± 3°F (23 ± 2°C) and 50 ± 5 % relative humidity for 24 h prior to testing.

S1.2.2 *Panel Preparations*—Unless otherwise specified in this specification, when tests are to be performed using test panels, the specimens of retroreflective material shall be applied to smooth aluminum cut from Alloy 6061-T6, in accordance with Specification B209 or B209M, sheets in 0.020-in. (0.508-mm) thickness. The aluminum shall be prepared in accordance with Specification B449, Class 2 or degreased and lightly acid etched before the specimens are applied. The specimens shall be applied to the panels in accordance with the recommendations of the retroreflective sheeting manufacturer.

S1.3 *Fungus Resistance:*

S1.3.1 For use in areas where fungus growth on retroreflective sheeting may be a problem, fungus resistance shall be determined as specified herein.

S1.3.2 After inoculation with the test organism, *Aspergillus niger*, and incubation for 14 days, the retroreflective material shall show no appreciable formation of fungus growth. Any formation of fungus growth shall be noninjurious to the retroreflective material and shall be removable by wiping with a soft cloth.

S1.3.3 *Test Organism*—The test organism used in this test shall be *Aspergillus niger*, ATCC Number 6275.[3] Cultures of this organism shall be carefully maintained on a potato-dextrose agar medium and promptly renewed if there is evidence of contamination. The stock cultures may be kept for not more than 4 months in a refrigerator at a temperature between 37 to 50°F (3 to 10°C). Subcultures incubated between 82.4 to 86°F (28 to 30°C) for 10 to 14 days shall be used in preparing the inoculum.

S1.3.4 *Culture Medium*—The culture medium shall have the following composition:

$NaNO_3$	3.0 g
K_2HPO_4	1.0 g
$MgSO_4 \cdot 7H_2O$	0.5 g
KCl	0.25 g
Agar	15.0 g
Distilled water to make 1000 mL.	

S1.3.5 The pH shall be 5.5 to 6.5: if otherwise, adjust to that range with HCl or NaOH. After mixing, the ingredients shall be sterilized by autoclaving for 15 min at 15 psi (103 kPa) at 248°F (120°C). Under sterile conditions, the medium shall be poured into six petri dishes (150 by 20 mm), about 2.2 oz (65 mL) per dish, and allowed to harden.

S1.3.6 *Inoculum*—Add about 0.34 oz (10 mL) of sterile, distilled water containing about 0.005 % of nontoxic wetting agent to a subculture (10 to 14 days old) of the test organism in a ripe, fruiting condition. The spores shall be forced into suspension with a sterile camel's hair brush (or other suitable means) and diluted to 3.4 oz (100 mL) with sterile, distilled water.

S1.3.7 *Preparation of Specimens*—Cut three 3 by 3-in. (76 by 76-mm) specimens from the sample and apply to test panels with the retroreflective surface up. Completely immerse the test specimens in a leaching tank of continuously flowing water for 24 h and then remove and dry. The leaching tank shall be large enough to hold an amount of water weighing not less than 50 times the weight of the specimens. The water entering the tank shall not fall directly on the specimens and shall flow at a rate of 1.3 to 2.6 gal/h (5 to 10 L/h). The pH of the water shall be in the range of 6.0 to 8.0.

S1.3.8 *Inoculation*—Under aseptic conditions, dip each specimen in 70 % ethanol for a few seconds, rinse in distilled water, and place firmly on the surface of the solidified agar medium contained in the petri dishes. Place specimens with the retroreflective surface facing up, one specimen to each dish.

[3] Available from the American Type Culture Collection (ATCC), 12301 Parklawn Dr., Rockville, MD 20852, or Mycology Laboratory, PRL, U.S. Army Natick Laboratories, Natick, MA 01760.

With a sterile pipette, distribute 0.03 to 0.05 oz (1.0 to 1.5 mL) of inoculum over the surface of each specimen and the surrounding medium.

S1.3.9 *Incubation Period*—The period of incubation shall be 14 days at a temperature between 84.2 to 89.6°F (28.9 to 32°C) and 85 to 90 % relative humidity.

S1.3.10 *Control*—Test three control specimens of untreated, porous-grade filter paper with the specimens of the retroreflective material to check the viability of the inoculum. At the end of the incubation period, the controls should be covered with fungus growth.

S1.3.11 *Test Results*—Upon completion of the incubation period, examine the specimens visually for fungus growth. Wipe the specimens with a soft cloth wet with a 70 % ethanol solution. Visually examine the specimens for damage resulting from fungus growth. If no pitting or textured surface is found, the sample will be reported to have passed.

S2. Reboundable Sheeting Requirements

NOTE S2.1—Not all types of sheeting are available in reboundable form.

S2.1 *Performance Requirements:*

S2.1.1 *Impact Resistance*—Retroreflective sheeting shall show no cracking or delamination outside of the actual area of impact when subjected to the impact test in accordance with S2.2.1.

S2.1.2 *Flexibility Requirements*—The sheeting shall be sufficiently flexible to show no cracking when tested in accordance with S2.2.2.

S2.1.3 *Adhesion*—When tested in accordance with S2.2.3, the adhesive backing of the retroreflective sheeting shall produce a bond to support a 1¾-lb (0.79-kg) weight for adhesive classes 1, 2, and 3 or a 1-lb (0.45-kg) weight for adhesive class 4 for 5 min, without the bond peeling for a distance of more than 1 in. (25.4 mm).

S2.1.4 *Outdoor Weathering*—The retroreflective sheeting shall be weather resistant and show no appreciable cracking, scaling, pitting, blistering, edge lifting, or curling, or more than 1/32-in. (0.8-mm) shrinkage or expansion after outdoor exposures specified in 7.6. The outdoor exposure time and minimum coefficient of retroreflection (R_A) after exposure is specified in Table S2.1. Retroreflectivity measurements after outdoor weathering will be made only at 0.2° observation and –4 and +30° entrance angles.

S2.2 *Test Method:*

TABLE S2.1 Minimum Coefficient of Retroreflection (R_A) and Required Outdoor Exposure Times

Type	Months	Minimum Coefficient of Retroreflection (R_A)
I	12	65 % of Table 1
II	12	65 % of Table 3
III	12	80 % of Table 4
IV	12	80 % of Table 5
V	12	80 % of Table 6
VI	6	50 % of Table 7
VIII	12	80 % of Table 8
IX	12	80 % of Table 9
XI	12	80 % of Table 10

S2.2.1 *Impact Resistance*—Retroreflective sheeting, applied to a 3 by 5 by 0.040-in. (76 by 127 by 1.016-mm) 6061-T6 aluminum test panel as specified in 7.2 and test conditioned as specified in 7.1, shall be subjected to the impact of a 4-lb (1.82-kg) weight, with a 5/8-in. (15.8-mm) diameter rounded tip, dropped from the height necessary to generate an impact of 100 in.-lb (11.3 N-m).

S2.2.2 *Flexibility*—The sheeting shall be bent, in 1 s, around a 1/8-in. (3.2-mm) mandrel with adhesive contacting the mandrel. For ease of testing, spread talcum powder on the adhesive to prevent sticking to the mandrel. The test specimen shall be 2¾ by 11 in. (70 by 279 mm). The test temperature shall be 32°F (0°C).

S2.2.3 *Adhesion*—Apply the sheeting to a test panel, 0.040-in. (1.016-mm) minimum thickness, prepared as specified in 7.2. Bond 4 in. of a 1 by 6-in. (25.4 by 152-mm) specimen to a test panel. Condition (see 7.1) and then attach the weight to the free end and allow it to hang free at an angle of 90° to the panel surface for 5 min, without the bond peeling for more than 1 in. (25.4 mm).

S2.2.4 *Outdoor Weathering*—Test two panels in each location in accordance with Table 14. After panels have been exposed for the number of months listed in S2.1.4, wash and condition them in accordance with 7.6.2, then test for coefficient of retroreflection. Report the average of the coefficient of retroreflection measured at each geometry on the two panels from each exposure location.

S3. Artificial Accelerated Weathering

S3.1 *Scope*—This supplementary test may be used for provisional qualification of sheeting before the results from outdoor weathering are available. When they become available, the results from outdoor weathering take precedence over the results from laboratory-accelerated weathering tests.

S3.2 *Test Requirements*—Expose four replicate specimens for the times required in Table S3.1. The minimum length and width for test specimens is 2.75 in. (70 mm). Do not remove panels from the device during a water spray cycle. Make sure they are dry before removing them from the device. After exposure, wash and condition them in accordance with 7.6.2, then measure retroreflectance at 0.2° observation and at –4° and +30° entrance angles. The average retroreflectance of the four replicate specimens shall be at or above the minimum requirements described in Table S3.1. After exposure, the test specimens shall show no appreciable cracking, scaling, pitting,

TABLE S3.1 Exposure Times and Photometric Requirements for Artificial Accelerated Weathering

Type	Hours	Minimum Coefficient of Retroreflection (R_A)
I	1000	50 % of Table 1
II	2200[A]	65 % of Table 3
III	2200[A]	80 % of Table 4
IV	2200[A]	80 % of Table 5
V	2200	80 % of Table 6
VI	250	50 % of Table 7
VIII	2200[A]	80 % of Table 8
IX	2200[A]	80 % of Table 9
XI	2200[A]	80 % of Table 10

[A] When sheeting is specified for construction work zone applications, the laboratory-accelerated weathering time shall be 500 h.

blistering, edge lifting, or curling or more than 1/32-in. (0.8-mm) shrinkage or expansion. The specimens shall also conform to the requirements of Table 2 and Table 11, when tested in accordance with 7.4 and 7.7.

S3.3 *Test Conditions*—Conduct exposures in a filtered open flame carbon-arc exposure device in accordance with the requirements of Practices G151 and G152. The spectral power distribution of the filtered open flame carbon-arc shall be in accordance with the requirements in Practice G152 for carbon-arc with daylight filters. Use the following exposure cycle:

Continuous light with equilibrium black panel temperature controlled to 145 ± 9°F (63 ± 3°C).
Once every 2 h (120 min), spray water on specimens for 18 min.
In devices capable of controlling chamber humidity, maintain relative humidity at a 50 ± 5 % equilibrium during the light-only interval

APPENDIXES

(Nonmandatory Information)

X1. Related Information

X1.1 Other Specifications

X1.1.1 American Association of State Highway and Transportation Officials. AASHTO designation M 268-03.[4]

E1247 Practice for Detecting Fluorescence in Object-Color Specimens by Spectrophotometry

[4] Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, http://www.transportation.org.

X2. Correction Factors for Conversion from Illuminant C to Illuminant D65

X2.1 Table X2.1 lists the correction factors to change measurements made using Illuminant C to approximate measurements made using Illuminant D65.

TABLE X2.1 Correction Factors for Conversion from Illuminant C to Illuminant D65

NOTE 1—As an example, a blue sample which measured (x, y, Y) = (0.150, 0.150, 5.0) using Illuminant C would be converted to (0.149, 0.158, 5.0) to provide the result using Illuminant D65.

Color	x	y	Y
White	+0.003	+0.014	0.00
Yellow	+0.001	+0.002	0.00
Orange	+0.001	+0.001	0.00
Green	+0.000	+0.019	0.00
Red	+0.000	+0.001	0.00
Blue	−0.001	+0.008	0.00
Brown	+0.000	0.000	0.00

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EXHIBIT 2

Negative

Date:	11/8/2005
Ballot Number:	D04.38 (03-05) Close Date: NOVEMBER 16, 2005
Item Number:	002 REVISION OF D4956-05 SPECIFICATION FOR Retroreflective Sheeting for Traffic Control WK9239(SEE VOLUME 04.03) TECHNICAL CONTACT: THOMAS C BLISSTCBLISS@MMM.COM(651) 737-2933
Member's Name:	JAMES M ROTH
Address:	OHIO DEPT OF TRANSPORTATION
	PO BOX 899
	1980 WEST BROAD ST
	COLUMBUS OH 43223-1102
Phone Nr:	6147520438 Fax Nr: 6146448199
Email Address:	JIM.ROTH@DOT.STATE.OH.US
File Attachment:	000156210_D0438000305_2.wpd

Statement:

I am voting negative on this ballot issue, since I am not convinced that the creation of a new type is justified. The impetus for the establishment of Type XI is based on the argument that the 3M company needs a method to identify their new DG3 material for marketing purposes. To establish a new type on this basis will result in a type with only one product conforming to the type. This is a bad idea, because it can create the illusion of a competitive environment to the casual user of the specification, when in reality, a proprietary condition exists. The only real beneficiary of this type of arrangement is for the company producing the proprietary product. I think we can do better than this.

When Types VII, VIII and IX were created, each represented a single, commercially available, material. In retrospect, we could have done better back then, but felt a need to get something in place to address these new materials, which were clearly much brighter that the existing Types III and IV. Coefficients of retroreflection were double and even triple the values for Types III and IV. There were concerns raised at the time about the wisdom of creating Types VII, VIII and IX, and it was largely understood that this would be an interim measure to get something on the books, with the intent of fixing it at a later time. Subsequent attempts to improve the situation were met with resistance, such that no changes have ever been made to the photometric values for these types. This experience exemplifies the need to move cautiously now, as we consider creating yet another type, as these actions will be difficult, or impossible, to undo later.

Type X was recently added to the specification, based primarily on the prismatic sheeting of Nippon Carbide. It was argued by the 3M company that creating a new type around only one product was a bad idea, even though we had done just that in the creation of Types VII, VIII and IX. The task group agreed with the arguments presented by 3M, and pushed the photometric

numbers downward, so that the Type X designation would cover not only the Nippon Carbide sheeting, but also one under development by 3M.

Another recent development in the specification was the adjustment of the photometric values for Types IV and VI to reflect current marketplace. This action recognized that photometric values for the types need not be static, but can be revised as necessary as available products are improved upon.

The 3M company has recently indicated their intent to phase out the VIP sheeting sold as Type IX. The new DG3 material will effectively replace the VIP product line. In this manner, the DG3 material could be considered as an enhanced Type IX. Instead of creating a new Type XI, I believe we would be better served to simply adjust the Type IX photometric values once the VIP is phased out, to reflect current marketplace. The precedent to do this has been set with the Type IV and VI materials.

Avery Dennison has presented a counterproposal for the establishment of photometric tables for a new Type XI, to describe a new sheeting that they are producing. The task group has not yet had a chance to review this proposal, and needs to do so in the context of the current ballot. On the surface, it appears the proposed photometric values, if adopted, would achieve a competitive Type XI environment. However, the values would need to be dequirked, and I am still not convinced of the need to create a Type XI.

In summary, I am voting negative on this ballot, since I do not believe there is a need for another type. As a counterproposal, I am suggesting that the Type IX photometric values be adjusted to reflect current marketplace once the 3M VIP material is phased out, in such a manner as to provide a competitive environment for both the Avery Dennison T-9500 and 3M DG3 materials. Until such time as VIP is phased out, the VIP, DG3 and T-9500 materials can all be sold as Type IX products. Once VIP is phased out, the Type IX photometric values can be revised.

Respectfully submitted,
Jim Roth, P. E.
Signing Engineer
Ohio Department of Transportation

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EXHIBIT 3

Negative
Vote from Non-Member

A negative from a non member does not stop the process of an item to the next level of balloting. The subcommittee is encouraged to consider the negative as this person will have the opportunity to vote negative at the main committee level.

Date:	11/17/2005
Ballot Number:	D04.38 (03-05) Close Date:
Item Number:	002 REVISION OF D4956-05 SPECIFICATION FOR Retroreflective Sheeting for Traffic Control WK9239(SEE VOLUME 04.03) TECHNICAL CONTACT: THOMAS C BLISSTCBLISS@MMM.COM(651) 737-2933
Member's Name:	BUONI, DREW J.
Address:	
	AVERY DENNISON
	1301 LU PLAZA, 2 WING YIP STRE
	REFLECTIVE PRDUCTS DIV
	Hong Kong
Phone Nr:	8522820456 Fax Nr: 8475887696
Email Address:	drew.buoni@ap.averydennison.com
File Attachment:	000253517_D0438000305_2.doc
Statement:	

Negative to Ballot Item #2, D04.38 Sub-Committee Ballot
Submitted by: Drew J. Buoni
November, 2005

I am voting negative on the ballot to add a Type 11 sheeting to ASTM D-4956 for two different reasons:

Reason #1: Task Group work is incomplete.
Although I was unable to attend the June, 2005 ASTM meeting, it is my understanding that the Task Group on Retroreflective Sheeting took an initial look at a possible Type 11 specification. Further, it is my understanding that numerous issues and arguments were raised at that meeting, and at that time, the Task Group unofficially voted against adding a Type 11 specification until the various issues could be addressed. At this time, however, none of these issues appear to have been addressed, but there is now an official Sub-Committee Ballot proposing the very same specification that was previously voted against at Task Group. As such, the Ballot at hand should be voted down and withdrawn until such time as the issues raised during Task Group have fully been addressed.

Reason #2: An alternative specification for a Type 11 sheeting will eliminate both future confusion and the unnecessary proliferation of additional sheeting Types within ASTM.
Many people on this Sub-Committee will remember the confusion caused in the market place five years ago when ASTM D-4956 originally added Type 7, 8, and 9. Although all of these specifications represented a significant boost in performance compared to Type 3 High Intensity sheeting, they were all slightly unique and different in their own independent ways. Generally speaking, Type 7 and 8 created a new class of sheetings with strong performance at medium and long distances. Type 9 excelled at shorter distances. As a result of ASTM adding three new specifications for micro-prismatic sheeting based largely on manufacturer product specifications, each State, City, and County needed to make a decision on how to implement these new specifications. With only some guidance from the various reflective manufacturers, there was a sizeable amount of confusion in the market. Some States combined all three into a single specification. Others, selected only one of the three specifications. In the end, end-users were not truly served by adding three product specifications to D-4956.

Although I am generally against adding a Type 11 specification to ASTM because many of the issues raised at Task Group have not been addressed, there is one fairly strong reason to add *a* Type 11 specification (although *not the proposed* Type 11 specification). The general retro-reflectivity attributes suggested by the ballot combine most of the performance attributes of Type 7, 8, and 9 (and now 10) into a single ASTM Type. This is appealing because it will eliminate much of the previous confusion by adding a single category to capture most aspects of the existing ASTM micro-prismatic sheeting Types. Unfortunately, the specific proposal for a Type 11 sheeting will result in a proprietary specification for a single manufacturer and should not be adopted. An alternative specification is needed (as outlined below).

Many members on this Sub-Committee may not realize it, but the product (DG3) outlined by the current ASTM ballot is a heavily patented and proprietary product. 3M Company

has filed and received many patents on this product. As such, ***adopting the current Type 11 proposal will result in a proprietary and monopolistic position for 3M.*** Consider the following claims in a recent 3M patent application (Reference US 20040174601A1), which is just one of many 3M patents on their DG3 product.

> Claim 41: Retroreflective sheeting comprising an array of preferred geometry cube corner elements that exhibits an average brightness at 0° and 90° orientation according to ASTM D-4956-01a of at least 375 cd/lx/m2 for an entrance angle of –4° and an observation angle of 0.5°.
>
> Claim 42: The retroreflective sheeting of Claim 41 wherein the average brightness is at least 400 cd/lx/m2.

By incorporating the performance levels of 375 and 400 cd/lx/m2, these claims essentially cover the proposed ASTM ballot. This would essentially block other manufacturers from producing a Type 11 product. 3M Company will argue that these patents only represent a single technology or single method to create this new class of sheetings. And while it is true that other technologies may exist, the fact is that 3M Company has so many patents surrounding the DG3 product, it will be nearly impossible for any other manufacturer to achieve the retroreflectivity performance outlined by the existing Type 11 proposal.

This Sub-Committee is again at a cross roads. If it votes to add the proposed Type 11 specification to D-4956, it will open the door for additional product specifications in the future as no other reflective manufacturers will be able to produce a Type 11 sheeting. Within a few years, there will probably be Type 12 and Type 13 specifications added to ASTM. This will bring us to back to the same positions as when Types 7, 8, and 9 were originally adopted. An alternative path is needed.

Listed below is an alternative retro-reflectivity table for a Type 11 sheeting that will allow competition, but will still achieve the goals of combining the performance attributes of Types 7, 8, 9, and 10 sheetings:

- By incorporating the same 1.0 observation angle values of Type 9 sheeting, it incorporates strong short-distance performance characteristics at both –4 and 30 entrance angles.
- It provides a boost of nearly 25% at –4 entrance angle and 0.5 observation angle to provide stronger performance at short-to-medium distances.
- The long distance performance at –4 entrance angle and 0.2 observation is more representative of the long distance performance provided by Types 7, 8, and 10.

	White	Yellow	Orange	Green	Red	Blue	Brown	FYG	FY	FO
0.1/-4	750	560	280	75	135	37	22	600	450	225
0.1/30	370	280	140	37	74	17	11	300	220	110
0.2/-4	525	395	195	52	95	30	16	420	315	155
0.2/30	215	162	82	22	43	10	6.5	170	130	65
0.5/-4	310	230	116	31	56	18	9.3	245	185	93
0.5/30	135	100	50	14	27	6	4	110	81	41
1.0/-4	80	60	30	8.0	16	3.6	2.4	64	48	24
1.0/30	45	34	17	4.5	9	2.0	1.3	36	27	14

Overall, this alternative specification is a small departure from the existing proposal, but will still achieve the goals of providing an open, competitive market and a specification combining the performance attributes of Types 7, 8, 9, and 10.

3M Company and 3M Innovative Properties Company v. Avery Dennison Corporation
Civil Action No. 10-cv-02630-MJD-FLN

EXHIBIT 4

Mark Kleinschmit/NA/AveryDennison
03/25/2006 10:38 AM

To "Smith, Dan" <dsmith@astm.org>
cc ALAN@ATSMINC.COM, ANTHONY.GOODSON@CI.RALEIGH.NC.US, AWEIGEL@CITYOFFARGO.COM,
bcc
Subject Re: Type XI Patent Information

History: This message has been forwarded.

Hello everyone,

As you may remember from the meeting in Dallas, Avery Dennison promised to provide some information to the ASTM organization on 3M's patent position around the Type XI specification. After some discussion with Dan Smith, and the ASTM organization, we determined that ASTM general counsel was not really in a position to evaluate the patent situation. So, I told Dan that I would be providing the patent information to the subcommittee.

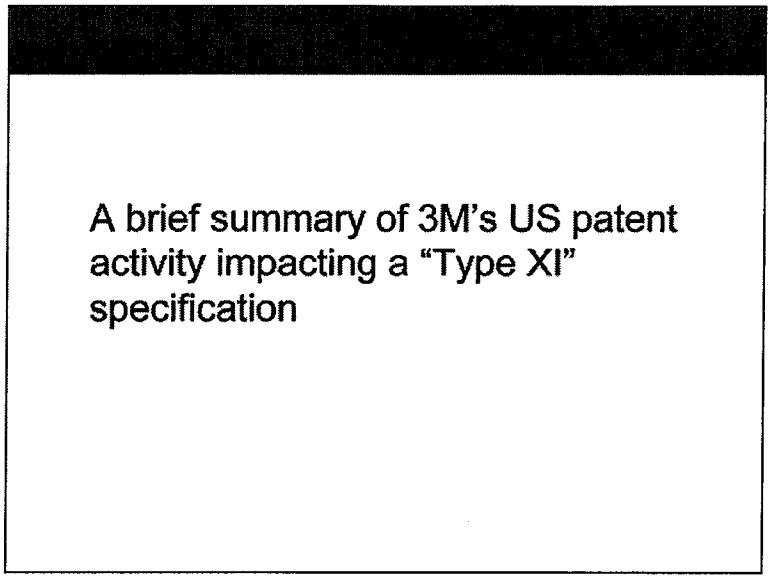
I have to admit, I think the subcommittee itself is not in a much better position to evaluation patent coverage - we have very few intellectual property attorneys in the subcommittee. But I would still like to share the information that we have received from our attorneys. And I apologize for the delay - it is not easy to get time with our own patent attorneys!

I have done my best to try to summarize the patents and the "gist" of each one. The results are in the attached powerpoint presentation. I have included the document numbers, and anyone can pull the appropriate documents from the US Patent and Trademark Office

The main point is that retroreflective performance has been claimed by 3M Company. This means that the specification itself has been claimed.

http://www.uspto.gov/

3M Type XI Patent Information.ppt

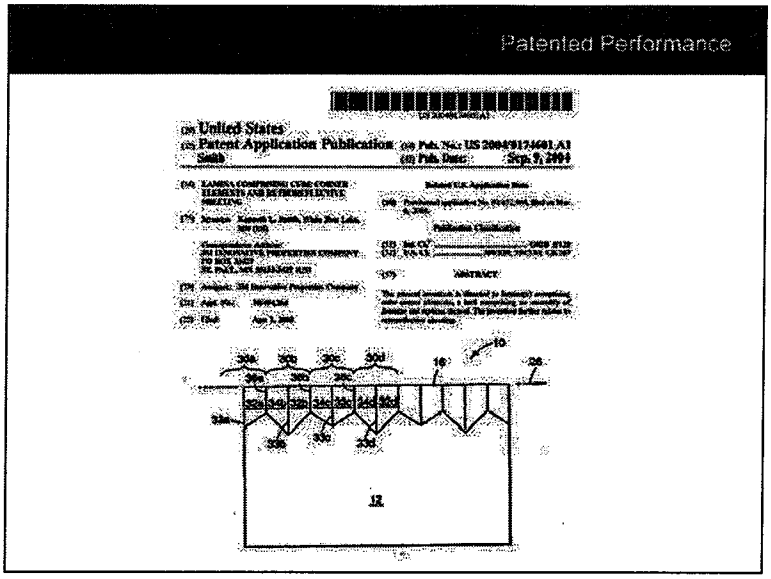


We would like to present some evidence that Tipo X, as proposed, constitutes a specification for a proprietary, or sole-source product. The only benefit from granting this specification would be to 3M, not to the users, and certainly not to the people of Brazil.

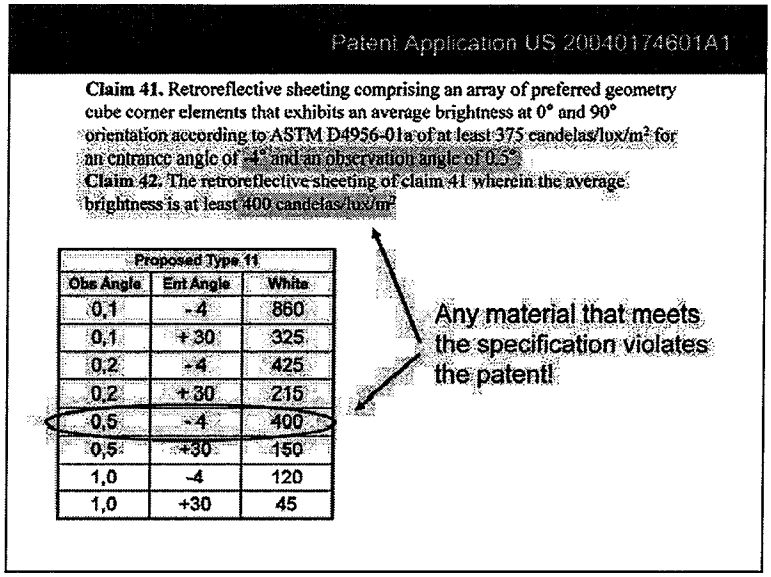
Patents and Type XI

Any material that can meet the proposed Type XI will likely violate a 3M patent through:

- Retroreflective performance
- Design
- Manufacturing process

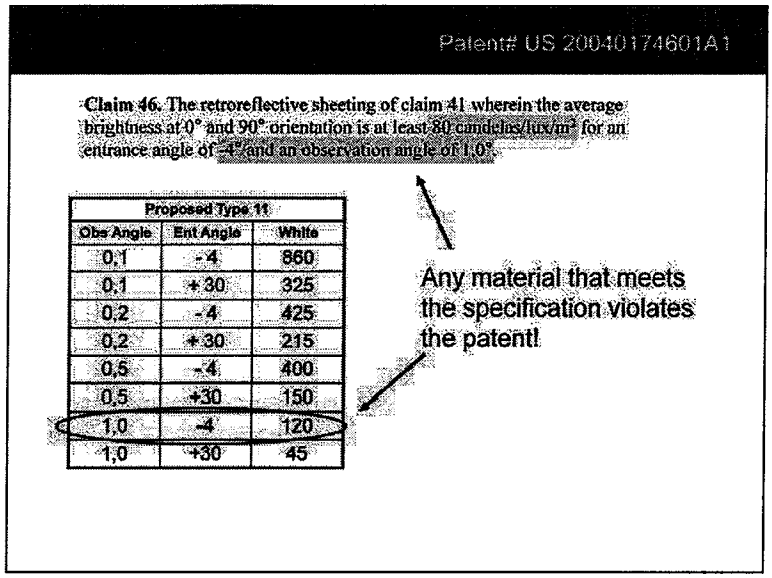


In this patent, 3M has gone beyond the patenting design or manufacturing, they have patented standardized testing performance!



Claim 41 and 42 state that, for any sheeting with a general cube-corner design, if the sheeting achieves a minimum performance of 375, or 400 cd/lx-m^2 (when measured with the standard test method), then it is in violation of the patent.

Notice, that in order to meet their proposed specification – you MUST violate this patent. Granting the specification allows ONLY their product – any other products would be in violation and thrown into court!



Similarly, they have claimed performance at 1.0 observation angle – though now, ANYTHING above 80 cd/lx-m^2 is in violation. This is even MORE severe than before. Again – this kind of patent turns the specification into a law-suit trap!

Patented Design

In order to meet the specification, a reflective material must have nearly 100% (head-on) "actively" reflecting area

There are two ways to do this, either "hexagonal" or "rectangular" cubes

3M holds many, many patents on hexagonal cubes...

But what about rectangular cubes? (ala DG[3])

Rectangular Cubes

Patent #	Subject
US 5,981,032	Rectangular cube pairs on a single edge and how to make them
US 6,114,009	Rectangular cubes, where the cubes are made on a single edge, and all the cubes are aligned
US 6,447,878	Rectangular cubes, where the cubes are made on a single edge, and the cubes are not aligned
US 6,120,881	Rectangular cube-pairs, where the cubes are made on a single edge, and the cubes are not aligned

Rectangular Cubes

Patent #	Subject
US 6,257,860	Rectangular double-cube pairs on a single lamina
US 6,257,860	Rectangular double-cube pairs on a single lamina
US 6,318,987	Creating double-cube pairs on a single lamina at an off-angle
US (application) 2004/0212887	Array of prismatic cubes that cannot be made on a single flat surface

Rectangular Cubes

Patent #	Subject
US 6,386,855	Rectangular cube-pairs on a single edge where the cubes are not identical
US 5,898,523	Groups of rectangular cubes rotated with respect to their neighbors
US (application) 2004/0174601	Rectangular cubes with angle-errors resulting in photometric performance
US (application) 2004/0174603	Rectangular cubes with angle-errors and different cube-tilting

Manufacturing Methods

There are other patents covering the way reflective sheeting is made:

Patent #	Subject
US 6,253,442	Method of creating multiple rectangular-cube edges
US 6,884,371	Molding films with the channels running in the machine-direction (+/- 45 degrees)
US (application) 2005/0180012	Molding films with channels parallel to the long edge of a sheeting (+/- 45 degrees)

Conclusion

The patents show the clear intent to prevent any other manufacturer from making a similar product – many methods are patented that are not even utilized

You must have cube corners to meet the specification

But you can't have identical or non-identical cubes

You can't have cube pairs or single cubes on a single edge

You can't have tilted or cubes with errors

You can't have cubes lined up on an edge AND you can't have cubes that are NOT lined up along an edge

Conclusion

You can't have the cubes lined up along the direction of embossing and you can't have them lined up 90 degrees from the direction of embossing

If you can determine how to design a cube that they haven't, you probably cannot make the cube without violating their patents

3M Company and 3M Innovative Properties Company v. Avery Dennison Corporation
Civil Action No. 10-cv-02630-MJD-FLN

EXHIBIT 5

tcbliss@mmm.com
03/27/2006 02:34 PM

To JasonDavis@dotd.louisiana.gov
cc ALAN@ATSMINC.COM, ANTHONY.GOODSON@CI.RALEIGH.NC.US, AWEIGEL@CITYOFFARGO.COM,
bcc
Subject Re: Conference call for March 28

History: This message has been forwarded.

Dear All,

One of the questions from today's teleconference was : What proof is there that the patent claims that relate to the ASTM performance standards, which formed the basis for a couple of the negatives, have been withdrawn as stated in the Motions?"

Here is a copy of a page from the US Patent Office website with the withdrawal of these claims highlighted
(See attached file: USPO Claim Withdrawal.doc)

For those who want to dig in deeper - the patent office website containing this document (non-final rejection dated 1/11/05) is:

http://portal.uspto.gov/external/portal/!ut/p/_s.7_0_A/7_0_CH/.cmd/ad/.ar/sa.getBib/.c/6_0_69/.ce/7_0_1ET/.p/5_0_18L/.d/1?selectedTab=ifwtab&isSubmitted=isSubmitted&dosnum=10404265

2 additional points:

1: No patents claims contained in the application have been granted to date

2: Per ASTM counsel, the Standard would not need any statements regarding patented materials based on this proposal (Dan Smith - please amend this point if I mis-heard your statement)

regards

Tom C. Bliss
3M Center Bldg. 235-3B-55
Tel: (651) 737-2933

Fax: (651) 733-6211

USPO Claim Withdrawal.doc

Office Action Summary	Application No.	Applicant(s)	
	10/404,265	SMITH, KENNETH L.	
	Examiner	Art Unit	
	EUNCHA P. CHERRY	2672	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).

Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 26 October 2004.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-54 is/are pending in the application.

4a) Of the above claim(s) 21-34 and 41-54 is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-20 and 35-40 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 01 April 2003 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 5/16/03, 1/4/05.

4)☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: _____

U.S. Patent and Trademark Office
PTOL-326 (Rev. 1-04) Office Action Summary Part of Paper No./Mail Date 01052005

3M Company and 3M Innovative Properties Company v. Avery Dennison Corporation
Civil Action No. 10-cv-02630-MJD-FLN

EXHIBIT 6

JasonDavis@dotd .louisiana.gov
03/31/2006 12:00 PM

To Carl.Andersen@fhwa.dot.gov, bernie.arseneau@dot.state.mn.us, tcbliss@mmm.com, nljohnson@mmm.com, dmbums@mmm.com,
cc dsmith@astm.org
bcc
Subject Conference Call minutes

History: This message has been forwarded.

Conference Call attendees:

I am attaching the minutes from the 2 days of conference call for your review. If you see anything that needs to be revised, please let me know. If everyone approves, I'll send this out to the subcommittee for their review of the information.

Thank you all for your participation in the discussion.

Also, a big thank you to Carl Andersen for taking minutes on Monday.

(See attached file: Subcommittee D04-38 conference call 3-27-28-06.doc)

JasonDavis@dotd.louisiana.gov
LA Dept. of Transportation & Development
Materials Section
Ph. 225.248.4106

Fax. 225.248.4187 Subcommittee D04-38 conference call 3-27-28-06.doc

Subcommittee D04.38 Conference Call – March 27th – March 28th, 2006

March 27th, 2006 – 8:30 to 11:30 CST

Attendance

- Carl Andersen – FHWA
- Bernie Arseneau, Sue Groth – Minnesota DOT
- Tom Bliss, Norb Johnson, Dave Burns, Tom Simpson – 3M Corporation
- Charlie Bond – Nippon Carbide Industries
- Paul Carlson – Texas Transportation Institute
- Jack Cowsert – North Carolina DOT
- James Foster – Mobile County Engineering Office, AL
- Brook Jerzyk, Chris Gaudette, John Delude – Reflexite Corporation
- Mark Kleinschmit, Steve Chapman, Joe Gao – Avery Dennison Corporation
- Henry Lacinak, Jason Davis – Louisiana DOTD
- Eric Nelson – Gamma Scientific
- Jim Roth – Ohio DOT
- Dan Smith - ASTM
- Jim Stewart – Vulcan, Inc.
- Jim Swisher – Virginia DOT
- Ken Uding – Retroreflection Advisory
- Al Weigel – City of Fargo Engineering Office, ND
- Paul Vinik – Florida DOT
- Norman Yamaguchi – Novabrite

A conference call for ASTM Sub-committee D04.38 was held from 9:30-12:30 EST on Monday, March 27, 2006. Jason Davis, Chair of the sub-committee, introduced the people participating in the conference call, and asked for questions regarding the ground rules for discussion.

There were no concerns with the established ground rules, provided to all on Friday, March 24, 2006 by e-mail. The intent of the conference call was to allow discussion of the negatives received on D04.38 Ballot 05-03, the motions to find the negatives non-persuasive and rebuttals to those motions from the original negative voters (see materials provided by e-mail from Dan Smith, ASTM Staff Liaison, on Monday, March 20, 2006). Due to the number of negatives, and the length of the previously provided written discussion, a limit of 10 minutes was proposed for each item. This format, however, did not survive the discussion of the first negative. Rather, the discussion flowed from topic to topic, rather than being specific to each negative, as many of the discussion items are closely related.

The first comment was directed toward part of the motion to find the negative submitted by LA DOTD as being non-persuasive, and the rebuttal to that motion. The motion to find the negative non-persuasive stated that: "There is a need for a new type," while the rebuttal stated: "A new type is not needed for the single sheeting meeting this specification to be sold."

- The comment from Carl Andersen was that adoption of a new ASTM Type should be based on a determination of whether or not a new sheeting material is substantially different from the existing types, such that D4956 does not adequately define the performance (R_A values at specified geometries) of the sheeting. Neither statement: there is or is not a need for a new type, covers the essential elements.

- Bernie Arseneau stated that a field evaluation of DG3 sheeting was the basis for his belief that the proposed Type XI should be added, as the new material "...provides improved performance that is closer to driver requirements."

Mark Kleinschmit suggested the idea of specifying multiple types in a state specification may be a new idea (i.e. a material shall meet ASTM Type VIII and IX rather than VIII or IX). It was agreed that it may be more confusing to specify materials in this way.

Chris Gaudette said the motion to find the negatives not persuasive indicate a "need" for a new type, but that need has not been given. Bernie Arseneau said the need is based on safety. Tom Bliss said the need is to keep the specification current with currently available materials, and that the information regarding these new products needs to be available.

Jim Swisher asked if the sub-committee had developed a consensus on what level of change in performance would warrant addition of a new type to D4956.

Henry Lacinak gave a brief history of the pre-year 2000 evolution of the D4956 specification and the addition of the various types.

> When Type II, III, and IV were added, Type I had competition from different manufacturers. Type III was available from only 3M. Type II was introduced by Seibulite as an incremental step between I and III. Type IV was introduced by Stimsonite as a prismatic (Type III was covered by patents at the time) with values similar to Type III. The specification values added were based on the manufacturer's literature for the specific products. Types VII, VIII, and IX when introduced, also were product specific. Types VII and IX were produced by 3M, and Type VIII by Avery Dennison.
>
> Ken Uding said a justification existed for adding Type II due to differences in retroreflectivity performance; the change in R_A values for Types I to II averaged an increase of 88%. From Type II to III the average increase was 112%. The decision to add Type IV, rather than include the prismatic high-intensity sheeting under Type III, was due to the differences in appearance of beaded and prismatic sheeting under changing orientation angles. While the R_A values for Type III and (original) Type IV are similar under co-planer geometry, there was concern about mixing the materials on a sign due to noticeable differences in luminance under "real world" geometries. Thus, the sub-committee has considered the performance of sheeting at geometries other than those specified for qualification under an ASTM Type in the past.

The testing procedures for qualification under an ASTM Type compared with R_A values under typical roadway viewing, was raised as an issue. Geometries on the roadway differ, sometimes significantly, from the geometries tested as part of the D4956 procedure. A discussion of "performance" versus "performance-based" was raised. Retroreflective "performance" is referred to as the retroreflectivity of a product at a specific geometry, and can be compared directly against other products at the same geometry. "Performance-based" evaluation refers to how the material performs compared with the needs of the driver. Task Group 04.38.09 has been established to determine the needs of the driver and to develop a performance-based specification to meet those needs.

Ken Uding stated that he had some concern with the AzDOT study that is cited as part of the justification for establishing a new type—that study only compared various sheeting materials

against a Type IV background, and was limited to visual evaluation of large, positive contrast guide signs. The retroreflective luminance and contrast provided by materials that meet the proposed Type XI R_A values for other sign types and positions are largely unknown.

Al Weigel indicated that he was a new member of the sub-committee, and was not fully conversant on the technical aspects of delineation between types; however, he participated in a field evaluation sponsored by MnDOT (the field evaluation mentioned by Bernie Arseneau) and stated that there were clear visual differences between signs manufactured with DG3 material and other ASTM Types. While the field evaluation did not provide quantitative numbers, it demonstrated to him the potential benefits of the DG3 material to the driving public.

Carl Andersen raised a concern regarding the large difference between the proposed values for Type XI and typical measured values that have been incorporated into the ERGO database. The values proposed for D4956 may result in some confusion, as the proposed Type XI does not appear substantially different from existing types on paper.

- Tom Bliss explained that the values proposed for Type XI reflect the impact of the de-quirking process. During de-quirking, the relative R_A values across entrance angles, for all observation angles, are averaged. This removes any single manufacturers "fingerprint," and insures that substantially similar materials can be included under one type designation.
- Mark Kleinschmit pointed out that when addition of Type X was under discussion, the sub-committee agreed with a proposal by Tom Bliss to modify the values for Type X, to insure that multiple products could be qualified under that type designation. It would seem prudent to follow that precedent with the proposed Type XI. There is a proposal to modify some of the R_A values for the proposed Type XI that would result in more than one sheeting being qualified under that type designation.
- A general discussion ensued on the need to establish a level of difference in R_A values that justify a new ASTM Type. Chris Gaudette, Brook Jerzyk and Henry Lacinak reminded the sub-committee of previous commitments to undertake just such a task. Norb Johnson remarked that there are efforts to develop criteria for establishing new ASTM Types, but that the work is long-term and it would not be in the best interest of the users of D4956 to freeze other work while that task is in progress.

Jim Roth commented that only 17 voting members were present at the call, and the discussions were not benefiting the members who have recently joined the subcommittee and were not attending the conference call.

Jason Davis advised that a second conference call would be held on Tuesday, March 28, 2006 to continue the discussion. He invited people to submit specific written questions that would be passed to the sub-committee members as a means of focusing the discussion during that call. While there was interest in delaying the start of the call, it was agreed that it would proceed as originally scheduled. Members were encouraged to advise the chair if they would be joining the call late, especially if they had a specific issue to discuss.

The conference call was concluded at 12:30 pm EST, with the discussion scheduled to resume on Tuesday, March 28, 2006 at 9:30 am EST.

March 28th, 2006 – 8:30 to 11:30 CST

Attendance

- Carl Andersen – FHWA
- Bernie Arceneau – Minnesota DOT
- Tom Bliss, Norb Johnson – 3M Corporation
- Paul Carlson – Texas Transportation Institute
- Jack Cowsert – North Carolina DOT
- Chris Davies – Potters Industries
- Chris Gaudette, John Delude – Reflexite Corporation
- Mark Kleinschmit, Steve Chapman, Tom Lagney – Avery Dennison Corporation
- Henry Lacinak, Jason Davis – Louisiana DOTD
- Philip Lancaster
- Tom McTighe – Tape Technologies, Inc.
- Eric Nelson – Gamma Scientific
- Jeff Osburn – Osburn Associates, Inc.
- Jim Roth – Ohio DOT
- Dan Smith - ASTM
- Jim Stewart – Vulcan, Inc.
- Jim Swisher, Pam Brooks – Virginia DOT
- Ken Uding – Retroreflection Advisory
- Paul Vinik – Florida DOT
- Norman Yamaguchi – Novabrite

Patent Issues

Conference call began at 8:30 CST with a discussion of 3M's patent claims regarding the DG3 material. John Delude asked for an interpretation of the current patent continuation claim as of January 12, 2006, and does it affect the previous claim withdrawal?

Tom Bliss said he spoke with their patent attorney on March 27th. The claims regarding the retroreflectivity at ASTM specific geometries have been withdrawn, although he is not sure what the final patent will look like (takes time to go through the process). The world patent claim has been withdrawn as well, but hasn't been addressed by the patent office at this time.

Steve Chapman remarked that the new claims from January 12 were similar in impact to the older claims.

Carl Andersen noted that the January 24, 2006 filing shows the claims for performance levels at ASTM geometries have either been withdrawn or rejected. Two new claims deal only with the manufacturing process of the product.

Questions submitted by Subcommittee members:

Henry Lacinak – "What is the rush for establishment of a new grade of sheeting? Supporting data has been stated by some to be incomplete or inconclusive.

In an attempt to not repeat past mistakes, wouldn't it be better if we approached the revisions to these specifications (and additions of new types) in a more logical and structured approach? Items discussed in past meetings include an increase of double the retro values in order to have significantly different performance. While doubling values may be excessive, shouldn't we first establish some parameters such as this in order to have a guideline as to the structure, rather than "discover" a new type and try to "fit" it into the current scheme?"

Bernie Arceneau stated there are various reasons for the introduction of the various types, but we don't need to look at new ways to introduce new types on the cusp of adding a significantly new sheeting. We should add the new type and then look at combining types.

Carl Andersen stated that Bernie's comments have been discussed after previous types had been added, and that we have been looking at this issue for some time. The task group recommended that the Type XI proposal should not be balloted. However, an executive decision was made by the previous subcommittee chair to send the item to ballot to document the negative feedback.

Norb Johnson and Tom Bliss commented that attempts to combine types in the past have not addressed performance differences in the different types of materials, and that it had been agreed that new types may have to be added under the current system until a new system was developed.

Philip Lancaster commented that no momentum has been made of previous commitments documented in the minutes of previous meetings to combine types, and that the perception of the subcommittee may be hurt by not fulfilling commitments.

Carl Andersen responded that attempts have been started, but it takes time to move forward because of the complexity of the issue.

Jim Roth asked if the specification numbers for the proposed Type XI are the ones we want with just 1 product currently meeting the requirements.

Henry Lacinak noted in the December 2000 minutes of the subcommittee meeting issues regarding negatives submitted to adding similar Types VII and VIII and Type IX. Some of the negatives were withdrawn with the understanding that the task group would review the structure of the specification with the intent of combining new and existing types.

Chris Gaudette said approving Type XI will inevitably lead to Type XII, etc. Discussions of the new types stop the discussions of changing the process.

Charlie Bond – "NCI proposed a higher standard for Type X sheeting, however the committee agreed with the argument that "creating a new type around only one product was a bad idea" and recommended to reduce those standards, to allow for another manufacturer to produce a similar type, that did not materialize. Does the committee agree that there should NOT be a double standard, created by an expedited vote, without sticking to protocol in support of competition?"

Jim Roth noted the June, 2004 minutes show 3M had argued at the January 2004 conference call to lower the retroreflectivity values of the then proposed Type X material to accommodate a 3M product under development, but reversed this position at the June, 2004 meeting, voting negative on the ballot with the reduced values.

Henry Lacinak said if the committee feels higher retroreflectivity values at particular geometries are needed, we should move forward in that direction. If current products can provide those improvements over other types, can we develop a specification that provides those higher values and competition?

Ken Uding asked Jim Roth if he will continue his proposal of grouping types into classifications.

Task Group 04.38.01 for Retroreflective Sheeting was given the assignment to develop a modification to the D4956 Type scheme to have classifications based on similar performance. The task should refer to Jim Roth's original classification proposal as a starting point.

Mark Kleinschmit noted that no procedures have been agreed on to add new types, and individuals are using their own interpretations.

Jim Steward asked "Haven't sheetings gotten as bright as possible? Can we get much more performance?" Norb Johnson replied that light is being re-directed by changing the orientation of the prisms to meet the perceived needs of the driver, and that full disclosure of sheeting materials (comprehensive testing at a large range of geometries) is necessary. Ken Uding commented that the ERGO program has "full disclosure" data on numerous sheetings. ERGO is based on specific products, and does not currently contain data for ASTM Type IV or X, Omniview, or DG3, but can be updated with additional testing of these products.

Jim Roth referred to some user studies in Ohio that concluded Type VII, VIII, and IX were rated equivalent. The Ohio DOT specification currently reflect these findings.

Jim Swisher – "Although they may not relate directly, I have a question (for Paul and Carl) that ultimately will relate to VDOT's signing policy and a comment on my opinion of the needed direction of 4956

Question: I've noticed that when viewing a positive contrast sign with IX on IX **VS** IX on III that while the IX on III has a higher contrast ratio (CR), the IX on IX was easier to read. Why does this occur, and can this be expected with other highly prismatic sign material?

Comment:
Since many independent researchers have shown that retro values don't always indicate what the luminance curves show, ASTM should adopt these steps in defining Types by independent researchers:
1. Have any and all sheeting products measured for R sub A at all relevant geometries.
2. Calculate luminance curves for the products at the standard sign positions and with the standard car, SUV and truck.
3. Establish the luminance needs of the drivers for the standard sign positions and with the standard vehicles.
4. Assign the sheeting products to the ASTM Types.
Note on step 3: Since this will require much work, we should push to have the work done under NCHRP, etc."

Jim Swisher said his question was based on his own observations. Tom Bliss mentioned similar results in an Ohio study on older drivers, and that the higher luminance of the Type IX materials combined may provide more legibility benefit than the contrast ratio of Type IX

on Type III for older drivers. Paul Carlson's study also looked at contrast ratios and legibility on guide signs.

Jim Stewart said for shoulder-mounted signs, safety is more important on rural, less lit roads, and that these signs are more susceptible to viewing at odd angles. Jeff Osburn agrees that brightness is more important for shoulder-mounted signs for safety.

Mark Kleinschmit referenced Paul Carlson's paper "Basis for ASTM 4956 Type Designations for Traffic Signs" citing that large differences on the luminance graphs have not shown real performance improvements. He noted that on p.4 of the report, looking at the "threshold legibility", that the DG3 and T-7500 products are producing app. 16 cd/m2, where Omni-View produces app. 9 cd/m2, which should make the Type VIII and DG3 better choices for overhead guide signs. However, the threshold performance studies on overhead guide signs did not find any statistically significant difference between Type VIII and IX, so moving from 9 to 16 cd/m2 did not constitute a meaningful improvement for drivers. He also mentioned that luminance needs fall as you approach a sign, so further gains in luminance are not contributing to driver performance. Mark also noted that for large trucks, Paul's studies have not found any real complaints from truck drivers about poor performing signs, and that the luminance graphs don't take overhead running lights from a large truck (with a low observation angle) into account. Shoulder mounted signs show similar performance between DG3 and Omni-View, and Mark noted that according to the ERGO data, the DG3 loses 20% of its brightness if rotated 90 degrees, and that if the sign is twisted away from traffic by 5 degrees (common practice), DG3 offers no advantage at the legibility threshold. He noted similar conclusions regarding the curved road scenarios listed.

The group then continued the discussion of the luminance graphs in Paul Carlson's paper "Basis for ASTM 4956 Type Designations for Traffic Signs."

The meeting adjourned at approximately 11:00 CST.

3M Company and 3M Innovative Properties Company v. Avery Dennison Corporation
Civil Action No. 10-cv-02630-MJD-FLN

EXHIBIT 7

WK9239 Item 28

To: D04 Main Members

From: Jim Roth, Task Group Chair and Jason Davis, Subcommittee Chair

Re: Proposed Type XI to D4956

A proposal, submitted by Tom Bliss (3M), to add a Type XI to the D4956-05 Specification for Retroreflective Sheeting for Traffic Control was Item 2 of Subcommittee Ballot D04.38 (05-03). There were 15 outstanding negatives that resulted and they were all found not persuasive via a subcommittee administrative ballot. Therefore, the D04.38 (05-03), item #2 passed and this item is now being forwarded for voting at the main committee level.

The first portion of this item contains the 15 negative votes, the corresponding not persuasive rationale, and the subcommittee vote counts. The actual technical ballot item is found on the final few pages of this document.

Please contact Dan Smith at [dsmith@astm.org] if you have any questions regarding this letter ballot.

Negative Vote #1 - Jason Davis and Henry Lacinak, LA DOTD

I am voting negative on Item 2, WK 9239, for the following reasons:

1.The material described by the proposed specification indicates performance over a range of entrance and observation angles. As stated in the proposal, the retroreflectance values are similar at low observation angles to Type X (Type X encompasses Types VII and VIII) and at high observation angles to Type IX. This is a good case for a proposal similar to Jim Roths more generic category proposal, as well as Henry Lacinaks 1998 suggestion for a type with options for specific performance needs. Simply adding a new type will further confuse the users.

2.The proposal states that the material is currently available from only one supplier. As of October 19, a second manufacturer has introduced a material with similar performance characteristics as the proposed Type XI. Regardless of the actual performance numbers, if this second sheeting has similar performance characteristics (i.e. performance over the same range of entrance and observation angles) we should draft new performance numbers that take both of these products into account. Otherwise, we are simply inviting the inevitable Type XII which is similar to Type XI but not quite.

3.Also, the jury is still out on the field performance of this proposed material. Numerous states have withheld approval, or given only limited approval, to this proposed material due to insufficient field data. As stated in research reports by TTI and observations by

Virginia DOT, different orientations, sizes, and constructions of prisms can alter the long term performance stability of a sheeting material. Other research indicates that artificial weathering as per current ASTM procedures does not accurately describe field weathering, and should not be used for performance predictions.

As a comment, we can reduce the confusion to users of this specification by eliminating Type VII and VIII as was originally suggested and to which the task group concurred was the next logical step after incorporating Type X. If the proposed Type XI product has similar performance to Type IX, it may also be advisable to eliminate Type IX if Type XI is included as proposed.

Motion to find this Negative Not Persuasive

We move to find this negative not-persuasive for the following reasons:

There is a need for a new type. Arguments regarding the redesign of the standard to make it more performance-based are beyond the scope of this ballot item and are being addressed elsewhere. In the meantime we need to keep the standard current.

An independent study conducted by the Arizona Department of Transportation that compared high performing prismatic sheeting materials in a side-by-side presentation, although not entirely comprehensive in its scope, found that material meeting the proposed Type XI specification was judged better than the others tested. Numerous users have also conducted evaluations for which similar results have been reported.

Proving conformance to accelerated weathering is not a requirement for establishing a type. Even so, accelerated weathering which in accordance with the supplemental section of the standard can be used until outdoor weathering is available, has been completed and shows conformance to the proposed requirements.

Motion Passed 48-14-16

Negative Vote #2 - Brook Jerzyk and Chris Gaudette

Reflexite Corporation would like to vote negative on the proposal submitted to the committee.

The type being proposed currently meets or exceeds one or more of the existing performance levels of the specification. Uniqueness of a material based on few points within a limited array of geometries does not necessarily require new typing.

Reflexite Corporation believes that the addition of another type, type XI, at this time creates additional confusion for the users of this standard. The standard currently offers ten types. In some cases the ability to differentiate between the types is difficult at best. This concern has been covered at numerous meetings by the State Departments of Transportations that are members of the committee.

A standard should provide clarity and direction for the user (the specifying agency), hi addition, the standard should provide a minimum level of expectation for the ultimate end user (the driver). We have all agreed previously that the current D4956 does not fulfill these requirements. We have agreed that D4956 has become a QC document and a sales/marketing tool for specifying for manufacturer's materials.

Additionally, by continuing to add types with new criteria, such as a 1.0° observation angle, the committee endorses that geometry as needed/required by the driver. This will then become embedded in the thought process of the users and will become increasingly difficult to challenge. We do not need to look any further than the historical geometries in the D4956 standard (0.207-4°, 0.207+30°, 0.507-4°, and 0.507+30°). Research is beginning to show that there may be a need for wider observation angles in our evaluation of these materials. Why is 1.00° being chosen? It is a geometry chosen for convenience (it is twice 0.50°). The research may show that 0.75° or 1.25° is more appropriate and useful.

ASTM D4956 is a standard that is used globally and for many different devices (signs, drums, cones, conspicuity, etc) and will probably be referenced for many years to come. The committee should not try to revise or upgrade the current D4956. It is time to set this document aside and begin generating a new standard (DXXXX) that addresses the needs of the users and drivers.

Proposed standards and revisions are not to be promoted by individual members, task groups, sub committee, or committee until the committee has completed the work.

The point being made here is that the members of this committee cannot promote or imply that a material is a "proposed type". The designation does not exist nor can it be assumed that it will be until a work item is completed. What if the committee was working on more than one potential addition? There is no way of determining how the committee would list them.

This would also apply to the promotion of these new standards/revisions as they are being worked on.

Section F2.4 of the ASTM Guide, *Form and Style for ASTM Standards,* provides the following caveat to documents in process.

F2.4 *Working Document Caveat*—The Board of Directors approved the use of the "Working Document" statement to be stated on the front page of every draft document or manuscript from a committee. The following suggested and proposed statement shall be typed or stamped on the document:

This document is not an ASTM standard; it is under consideration within an ASTM technical committee but has not received all approvals required to become an ASTM standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of ASTM Committee activities except with the approval of the Chairman of the Committee having jurisdiction and the President of the Society. *Copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. All Rights Reserved.*

Anyone requesting an ASTM committee draft document (proposal standard, minutes, etc.) is entitled to receive a copy. However, after receipt of this document, they shall adhere to the caveat.

Since we have been discussing many ASTM regulations, procedures and formats it may be appropriate to point out to the committee Section 15, Patents and Standards, of the *Regulations Governing ASTM Technical Committees.* This area had considerable discussion at our June meeting with respect to IP and sole sourcing.

The section states:

15.1 The committee shall make an initial determination that a patented item (a material, product, process, or apparatus or constituent thereof) is required for inclusion in a proposed or draft standard. The committee shall, prior to the initial ballot, make efforts to determine whether alternatives to the patented item exist. If an alternative(s) exists, no reference to the patented item will be made.

15.1.1 The committee shall include with the ballot a statement of willingness to consider alternatives and a request for identification of alternatives to patented items. If an alternative(s) is identified, the committee shall reconsider whether the patented item is required and, if not, reference to the patented item will be removed.

15.2 When an approved standard requires the use of a patented material, product, or apparatus, the standard shall include a footnote requesting interested parties to submit information regarding the identification of alternatives to the patented items. The committee will promptly consider all identified alternatives.

15.2.1 If the committee determines that an alternative exists, the reference to the patented item, by name and number, shall be deleted from the standard by ballot.

15.2.2 References to patented items in ASTM standards shall comply with Section F3 of the Form and Style Manual.

15.3 ASTM Disclaimer of Liability as to Patented Inventions—Neither ASTM nor any ASTM committee shall be responsible for identifying all patents under which a license is required in using an ASTM document or for conducting inquiries into the legal validity of those patents which are brought to the Society's attention. Where applicable, an ASTM document shall include a note worded as follows: The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard* are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

Additionally, considerable discussion was held at several task group level meetings and members of the TG raised the following negatives and issues and the ballot has not addressed these items and concerns.

Jim Roth, Ohio DOT - Type XI Negative Comments

I am voting "negative" on the task group ballot submitted by 3M for the creation of Type XI sheeting, because it doesn't go far enough. As explanation and counterproposal, I offer the following:

I fear that the task group is in danger of losing all credibility if the practice of creating new sheeting types based solely on what the manufacturers can produce is perpetuated. This result is a proliferation of types containing a single product. We have been rightfully chastised in the past for doing this, and to continue to do this without addressing and correcting our past transgressions will further tarnish our image and bring into question our relevance.

ASTM D 4956 currently includes ten types of reflective sheeting. Types V and VI are specialized product specifications for materials intended for specific purposes. That leaves eight reflective sheeting types identified in ASTM D 4956 for use in "highway signing, construction-zone devices, and delineators". A proposal is now presented to create a ninth "highway signing, construction-zone devices, and delineators" type, based not on the wants of the users of the specification, nor the needs of the driver, but solely on the capabilities of a single manufacturer. This new proposed type will describe exactly one product on the market, similar to several of the existing D 4956 types. I believe the task group adds very little value to the process by simply assigning a generic type designation to a specific product on the market (except to provide the opportunity for agencies to create the illusion of competitive bidding for procurement matters, and as a marketing tool for the manufacturers).

The task group was initially hesitant to create a new type since the material from 3M had not been on the market very long, and the task group members had not had a chance to evaluate samples of the material. The idea being that if it could be shown that the new material performed as claimed by the manufacturer, that that would validate the need to create a new D 4956 type. It doesn't. All that proves is that the manufacturer has produced a product that performs to the performance criteria the manufacturer provided.

While this is certainly a good thing, it does not in and of itself establish a need for a new D 4956 type. Maybe it needs a new type, but maybe it is just a really good version of an existing type. A new type may indeed by warranted, but cannot be justified on this basis. The need for a new D 4956 type and the capabilities of a manufacturer to produce a product are separate issues. (A new type could theoretically be established prior to any manufacturer having a product that would meet the new type, with the manufacturers subsequently implored to produce a product to meet the new type requirements, such as when the California legislature mandates that the automobile manufacturers produce vehicles getting so and so miles per gallon with so much emissions, etc.)

It is widely recognized that D 4956 is confusing to the average user, and the task group is criticized for creating a specification that is little more than an available products list. The creation of a new type will compound the level of confusion. Many states, who are arguably the most informed users of the specification, often have not seen a need to keep the various types separate, and routinely combine them into fewer, composite types. States commonly combine Types VII and VIII, with some combining Types VII, VIII and IX. The message here is that many informed users of D 4956 see no reason to create a distinction between similarly performing types. The casual user of the specification is at the mercy of the sales representatives and state DOT to sort it all out. (I know I've been on this soap box before, but I'm going somewhere with this.) Even 3M acknowledges that there are an excessive number of sheeting types, and is planning to phase out four of the six products they currently produce, and will not further the development of their previously anticipated Type X material. (Or maybe their previously anticipated Type X has now become their proposed Type XI -I don't know. Regardless, 3M wrote the Type X retroreflective values contained in D 4956, and now has no plans to use them.) The 3M LDP Type VII product is no longer even included on their web page (although I did find reference to its existence on their Hong Kong site, but even then it was only a title sheet with no additional product information or data).

I have attached a counterproposal to this e-mail for your consideration. It creates the new Type XI as requested by 3M, but also attempts to accomplish some other things as well, as follows:

1.) It establishes a grading system for the broad classification of similarly performing reflective sheeting materials. This grading system was taken from my previous proposal to create a specification with only three classifications, but combines it with the type classification system currently in D 4956. The grading system will achieve the grouping of similarly performing materials under a single umbrella, such as is already being done by many state and other agencies throughout the country. But, by retaining the type system as well, will provide agencies wishing to do so the ability to further refine their specifications to a more precise level.

2.) It reduces the number of types by combining Types VII, VIII and X into a single type, called Type X. This is being done since the sole manufacturer of Type VII is planning to discontinue this product, eliminating the need for the type, and the recognition that Types VIII and X are similar enough such that separate types are not

warranted.

3.) It restores the Type X values to those originally proposed before 3M argued to have the numbers reduced to include a product they planned to produce but now won't.

The anticipated benefits to the proposal are as follows:

1.) 3M get their new type.

2.) Similar types are consolidated.

3.) The average user get a simplified sheeting "grade" system.

4.) The more complicated "type" system is retained for the more sophisticated user.

Ken tiding, consultant - Type XI Negative Comments

I am voting negative on the Bliss proposal.

I have made some comments, which explain my negative. Others are pertinent to either the Bliss proposal or the Roth counterproposal or to both. No doubt some comments have slipped in which may be primarily as response to comments by others.

Issues - in no particular order

If Type VII is no longer produced by its sole manufacturer, then the "combining" specification should ignore its values and reconcile only VIII and IX and perhaps X, and the new material. (This is not a suggestion as to which should be combined, only a note that VII can be dropped, as no one will produce it.)

New specifications and values at wider test points should be developed by actual observations. The current thrust toward 1.0 values corresponds to highway distances, which provide the highest luminance for most drivers observing signs of nearly any material. Lets look at actual signs from actual vehicles before we adopt changes based on "desk-top" engineering.

Wendy Ealding, VADOT - Type XI Negative Comments

I am voting negative on Tom Bliss's proposal to add a new Type XI for the following reasons:

1. We do not have sufficient information as to the improvement in performance that this new material represents, and if indeed it warrants a new Type. If we compare the existing Type III with Types VII-IX at 0.5 degree observation angle as shown in the attached spreadsheet, we can see that Types VII-IX have mean requirements of 243 at the -4 degree entrance angle and 128 at the + 30 degree entrance angle. (Making the

comparison at 0.5 degree observation angle is probably the closest we can come to driver-relevant geometry in D 4956, recognizing that D 4956 uses the coplanar geometry.) Now if we compare these values with the corresponding minimum values for Type III sheeting, that is 156% increase at the -4 degree entrance angle and a 97% increase at the +30 degree entrance angle. Paul Carlson, in his presentation at the April 2005 Visibility Symposium, stated that the published research indicates that "Types VII, VIII and IX perform statistically equivalent and statistically better than Type III beaded sheeting." So we can have some sense of what it takes to achieve improved performance. Taking that one step further, if we compare the proposed Type XI 0.5 degree observation angle minimum values (400 at 0.5/-4, 150 at 0.5/+30) with the current Type VII-IX minima, we are looking at a 64% increase at -4 and a 17% increase at +30 degrees. This is a much smaller difference, not much greater than the minima for Type IV (being promoted as "high intensity prismatic") compared with Type III beaded material. Nobody has presented any human factors evidence that the new material is statistically better than the existing Types VII, VIII and IX.

2. There is no outdoor weathering data for this material. It was submitted to NTPEP for the first time this year. 3M claims that it isn't new, that it is made from the same raw material and components as their Type DC product, and therefore it has "proven durability". But at the same time they are claiming a "unique optical design". We don't know how sensitive this unique optical design's on-road performance is to even small shifts in the cubes with weathering. We have not received the results of the artificial weathering (D 4956 S3) yet, and it appears that artificial weathering test was not conducted alongside material with known outdoor weathering performance.

3. There is increasing concern about the number of Types in D 4956. At the D04.38.09 Task Group Meeting in June 2004, the highest priorities were given to developing driver-relevant specifications and keeping the specifications simple. Jim Roth has made a number of proposals in this regard, seeking to reduce the number of fundamental performance levels to three or four. When we adopted the Types VII, VIII and IX specifications as separate Types in 2000, (published as D 4956-0la) we had a negative from Alan Lafferty (formerly with Florida DOT) that was withdrawn with the commitment from the Task Group to consider combining these Types at a later date. At that time, we had a concern about unintended consequences of combining these Types since we didn't really know what their on-road performance was. Now the experience and research is telling us that they're more alike than we first thought. In Virginia, we're moving towards a fluorescent orange specification that will allow Types VII, VIII and IX as equal alternates, but we are adding 1.0 degree observation angle requirements to the Type VII and VIII specs. Interestingly, at the recent NTPEP meeting, Brook Jerzyk suggested that NTPEP should petition ASTM to add 1.0 degree OA requirements to all prismatic specifications. It would make sense for ASTM to at least combine the Types VII and VIII specs perhaps with the caveat (?option) of a 1.0 degree OA requirement to ensure that luminance is maintained at some reasonable level at the shorter distances and to accommodate the changing vehicle population. I am not sure whether we should include Type X as well, although it is apparent from the volume of correspondence from users that I receive as D04.38 Subcommittee Chair, that adding

Type X has caused more problems than it has solved. At the Visibility Symposium, Paul Carlson confirmed the need to establish the on-road performance of Types IV and X, as well as the new 3M material. We should seek such information before rushing in to establish a new Type. 3M's new product can meet the existing Type IX specification, apart from some minor discrepancies at the 0.2 OA/+30 EA combination, that I take is due to the application of the rounding conventions. There is nothing to stop them from selling the material now, as a Type IX, on a provisional basis once the artificial weathering data is available for users who want to take the route cited in D 4956 S3.

Meanwhile, there are a number of other aspects of D 4956 that should be addressed. In Part 2 and 3 above, I have discussed the lack of artificial weathering data, and the apparent shortcomings of the test as it was performed. This is in part one of the shortcomings of the standard. There is no provision for requiring a material of known outdoor weathering performance to be tested alongside the new material. The Scope in Section S3.1 needs to be strengthened to not only require this, but also to require the producer to provide evidence such as a NTPEP submittal, that the new material is undergoing outdoor weathering.

Jim Swisher. VADOT - Type XI Negative Comments

I have not read up on all the latest proposals for this but in general I do NOT want to add another Type to 4956.
I was more in agreement with your suggestion on combining a few types.
As you may know, I will be taking over for Wendy when she retires in Sept.
As a result, I may need a little extra coaching for a while on some of these issues.
Thanks for your help!

Philip Lancaster, FL DOT- Type XI Negative Comments

I vote negative on this proposal to add an additional type as being requested. At this point there does not appear to be a significant difference in the material for creating this type when it could possibly fit into an existing type. The "possible fit" is where the additional information or maybe even some research would be needed. The observation angle requirements listed for this material may be designed for a specific purpose, but even some of the existing types may even present "similar" performance when being addressing the needs of the end user and from the end user perspective.

Jason Davis & Henry Lacinack, LA DOT - Type XI Negative Comments

Proposed Amendment to ASTM D4956-04 to include a new Type of sheeting (Type XI)

Henry and I have discussed this and both concur on this response.

We are voting negative on this ballot for the following reasons:

This product, when visually compared to the current Type IX material, does not exhibit

performance substantially different to warrant a new type. When compared to products representing Type X and VIII, the performance difference is notable at the higher observation angles, and therefore this and the Type IX are set apart. However, the Type IX and proposed Type XI are very similar in their performance, as it shown in the retroreflectivity tables for each product. For reference, all the prismatic materials outperform the Type III product at the generally observed geometries.

This product has not been around long enough to confidently determine a minimum outdoor weathering specification (Table 16). 3M has claimed that the different components of this material have all been weathered in other products, and that the construction of this product is similar to those having proven weathering performance. That statement does not take into account the different construction of the prismatic elements. Previous materials have been truncated cubes, whereas these are full cubes.

We recommend that since this material, both visually and numerically (per the ASTM tables), performs similar to the current Type IX, that it not be granted a new type. Instead, it can be fitted into the current Type IX specification even though its performance exceeds the listed minimums in certain areas.

Mark Kleinschmit. AVERY - Type XI Negative Comments

I am voting negative on this proposal on the grounds that it is not in the best interests of the committee, ASTM in general, nor the end user. We do no-one a favor if we continue to add products to a "standard" that are in fact stand-alone and available from only one manufacturer. Adding Type XI will not help purchasers - it will deceive them, and it will turn ASTM into a marketing tool.
I understand that it is customary that a negative be accompanied by a counter proposal, but in this instance I do not know if one exists. You are either for adding a new Type XI at this time or you are not - so my counter proposal is to not add a new type.

Type XI will impede competition and commerce We have heard that ASTM is in the business of aiding commerce. And commerce is indeed aided by the creation of consensus standards. They allow multiple manufacturers to agree on product basics and all can then supply similar products, thereby creating shared platforms for future development and creating competition and choice for the consumer. This is the public perception of items that can be referenced by an ASTM designation. If we add a Type XI we create the illusion that the purchaser is specifying a level of performance available from a group of products.

But we know that they are in fact creating a sole-source specification. If a purchaser desires DG3, they should call it out by name, and justify their wish to specify a sole-source product - and not hide behind an ASTM curtain.

Type XI performance may be patent protected Adding a Type XI is also problematic in that several of the performance requirements in the proposal may be protected by

intellectual property. Not only are specific designs claimed, certain SIA ranges (when measured with cited ASTM procedure) have been claimed. So this is not just a case of the first manufacturer blazing a trail for others to follow. It is staking out a claim where others may not trespass. ASTM would in the fullest sense be creating a sole-source specification. This may be good for a single company, but that does not constitute good "commerce".

DG3 already has a Type : Type IX
There is some consensus in the committee that a factor of 3 is needed for noticeable improvement in reflectivity. Using this reasoning DG3 is an enhanced version of Type IX. DG3 can be specified and purchased under the existing Type IX ASTM specification - and now that "Type" would be a truer "standard" where multiple products are available under the heading. Again, the point of a standard is not to specify a single product. Besides, there will not be any confusion as to which product the purchaser would receive from 3M as they have announced their intention to discontinue VTP. Now that Avery Dennison has created T-9500 Omni-View, Type IX will finally represent more than one product. This will not impede commerce, but it will encourage honest purchasing. Besides, the qualities of DG3 should make it easy to market without the need for an ASTM deception.

The only argument for adding Type XI is that we have done it before. But since we are not happy with the result, it is madness to continue this behavior. 3M voted against adding Type X on these very grounds. They may argue Type X was not "different" enough and Type XI is. But I suspect that that determination is always commercially biased.

We have all agreed, manufacturers and purchasers that D4956 needs to be simpler, not more complicated. I would sincerely like to revisit Jim Roth's proposal that we discussed briefly in Washington. I think we should not alter existing types as this would just cause confusion for contracts, purchasers and specifications around the country and the world. It also causes creates a moving target for manufacturers, which is serious hindrance in a world where three years of product testing is required (for most manufacturers) just to begin selling a product. Instead, we should create a parallel grading system, that is modeled on simple geometric ratios of performance. Everyone has agreed that this is our real goal. I suggest we spend some time working toward it. If we invest as much energy there as in Type XI, I know we will arrive sooner than anyone thinks.

Ikuo Mimura, NCI- Type XI Negative Comments

I NCI is voting "NEGATIVE" for the following proposals in Task Group D04.38.01

Introduction of proposed Type XI from 3M : Negative

Hereinafter, reasons are given.

II Objection on introduction of proposed Type XI from 3M.

1) First of all, 3M should present their proposed "Type X" to Task Group Members.

On the occasion of the first proposal for Type X, NCI proposed the combination of existing Type VII and VIII and an incorporation of NCI's new product (Type X). Unfortunately our first proposal for combined type was not accepted in Task group. Therefore, NCI again proposed an independent type as Type X. During the discussion on introduction of Type X, NCI proposed the following specification shown in Table 1.

[Table 1]

Proposed New Type X by NCI —A super-high intensity retroreflective sheeting having highest retroreflective characteristics at medium road distances as determined by the R_A values of Table 16 at 0.1° and 0.2° observation angle. This sheeting is typically an unmetalhzed microprismatic retroreflective element material Typical applications for this material are permanent highway signing, construction zone devices, and delineators.

Obs. Angle	Ent. Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluo. Y. Green	Fluo Yellow	Fluo Orange
0.1 [B]	-4	*800*	*600*	*300*	*80*	*120*	*40*	*24*	*640*	*480*	*240*
0.1 [B]	30	*400*	*300*	*150*	*40*	*60*	*20*	*12*	*320*	*240*	*120*
0.2	-4	*600*	*450*	*230*	*60*	*90*	*30*	*18*	*480*	*360*	*180*
0.2	30	*300*	*230*	*110*	*30*	*45*	*15*	*9*	*240*	*180*	*90*
0.5	-4	*240*	*180*	*90*	*24*	*36*	*12*	*7.2*	*190*	*145*	*72*
0.5	30	*120*	*90*	*45*	*12*	*18*	*6*	*3.6*	*96*	*72*	*36*
1	-4	—	—	—	—	—	—	—	—	—	—
1	30	—	—	—	—	—	—	—	—	—	—

[A] Minimum Coefficient of Retroreflection (RA) cd-lx -1 -m -2 .

[B] Values for 0.1° observation angle are supplementary requirements that shall apply only when specified by the

Meanwhile, Mr. Tom Bliss of 3M proposed an introduction of their newly developed product as another 3M's Type X. As a result NCI agreed the downward revision of Type X based on Tom's proposal shown in Table 2. However, NCI want to emphasize that this compromise is not our true intention.

[Table 2]

Proposed New Type X by 3M final Draft —A super-high intensity retroreflective sheeting having highest retroreflective characteristics at medium road distances as determined by the R_A values of Table 16 at 0.1° and 0.2° observation angle. This sheeting is typically an unmetallized microprismatic retroreflective element material. Typical applications for this material are permanent highway signing, construction zone devices, and delineators.

Obs. Angle	Ent. Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluo. Y. Green	Fluo Yellow	Fluo Orange
0.1 [B]	-4	*800*	*600*	*300*	*80*	*120*	*40*	*24*	*640*	*480*	*240*
0.1 [B]	30	*400*	*300*	*150*	*40*	*60*	*20*	*12*	*320*	*240*	*120*
0.2	-4	*560*	*420*	*210*	*56*	*84*	*28*	*17*	*450*	*340*	*170*
0.2	30	*280*	*210*	*105*	*28*	*42*	*14*	*8.4*	*220*	*170*	*84*
0.5	-4	*200*	*150*	*75*	*20*	*30*	*10*	*6*	*160*	*120*	*60*
0.5	30	*100*	*75*	*37*	*10*	*15*	*5*	*3*	*80*	*60*	*30*
1	-4	—	—	—	—	—	—	—	—	—	—
1	30	—	—	—	—	—	—	—	—	—	—

[A] Minimum Coefficient of Retroreflection (RA) cd-lx -1 -m -2 .

[B] Values for 0.1° observation angle are supplementary requirements that shall apply only when specified by the

Based on the above mentioned process, we can argue the following three cases.

Case 1: So far, nobody see 3M's Type X, I believe. If new proposal for Type XI from Mr. Bliss (Hereinafter refers as Bliss's Second Proposal) and his proposal for Type X (Bliss's First Proposal) is identical, NCI can accept his second proposed product as "Type X".

Case 2 : If these two proposal cover different products, we understand that Mr. Tom Bliss of 3M is obliged to present the Type X product covered by his first proposal shown in Table 2 to all committee members in

advance of an proposal of "Type XI" (his second proposal). Is this 1st proposal product is on commercial or submitted to NETPEP? Case 3 : NCI do not believe but if such product do not exist, Task Group have to turn back to clarify the basic rule and steps on the introduction of proposal process.

2) 3M should not cancel a sales of LDP on the assumption of introduction of Type XL

Type VII was proposed by 3M and is sold as 3M's Diamond Grade LDP to not only US but also to all over the world. We have to realize that ASTM Type VII is specified not only in US but also introduced to Latin American, Asian countries and Oceania (Please be noted that ASTM is international organization). In that meaning 3M has responsibility to keep providing LDP as proposer.

Notwithstanding this circumstance, 3M has announced the cancellation of LDP to US customers and DOTs. However remaining VIP product (Type IX) do not conform with Type VII, VIII or X specification. Therefore, it is evident that cancellation of LDP is based on the assumption of introduction of Type XI. We understand that such proceeding do neglect customer's intention or benefit.

3) Evaluation of "DG3" sample from 3M based on ASTM E810 is impossible.

The sample for Type XI do not conform with the sampling requirement based on E810 - 13. Also we do not have other colors other than white. Is this product have directional mark ? Therefore NCI cannot comment whether the sample conform with proposed Type XI from 3M.

3 So, NCI would like to propose to separate Jim's proposal for consolidated specification and Mr. Bliss's proposal for introduction of Type XI and to proceed an argument in a sequential order of proposal. We should take priority over Jim's proposal which was proposed more than 1 year ago.

Dennis Couzin, Consultant - Type XI Comments

I agree with your goal of conjoining sheeting Types into Grades — grades that make sense to application engineers.

The calculation exercise below should bolster your program.

An application engineer wants to know:

How bright is the stuff?

There is a single number that the *optical engineer* uses to answer this. It is the RT value. It is something like the big sum:

0.1 xRAatO.1°/4°
\+ 0.2 x RA at 0.2° /4°
\+ 0.3 x RA at 0.3° / 4°
\+ etc., perhaps to 2.0°, perhaps farther.

This sum resembles your average except:

(1) It includes all useful observation angles — obviously inconvenient, but important for evaluation.

(2) It weights the RA's at each observation angles differently.

(3) It is just for the entrance angle 4°. A second RT value can be figured for entrance angle 30°, and you might even average these two RT values.

What satisfies the optical engineer shouldn't satisfy the application engineer. The application engineer really wants to know:

How bright are the signs made from this stuff?

A sign or device made from the stuff will have different brightness at different distances or even at the same distances when we sit in different vehicles so we should do a little better than RT.

Let 0.2° observation angle represent 250 meters for the average vehicle.
Let 0.5° observation angle represent 100 meters for the average vehicle.
Let 1.0° observation angle represent 50 meters for the average vehicle.

(We're supposing right and left headlights make the same observation angle.)

Let sign illuminance at 250 meters be 0.0097 lux
Let sign illuminance at 100 meters be 0.053 lux
Let sign illuminance at 50 meters be 0.126 lux

(I used an UMTRI European headlight distribution for this, because headlights are heading that way.)

predict sign luminance at 250m to be [RA at 0.2°] x 0.0097
predict sign luminance at 100m to be [RA at 0.5°] x 0.053
predict sign luminance at 50m to be [RA at 1.0°] x 0.126

Declare the mid-to-long distance average luminance by the average of the first and second predictions.
Declare the mid-to-short distance average luminance by the average of the second and third predictions.
(The 0.5° observation angle figures in both these averages, giving it fashionable importance.)

Get rid of the unnecessary decimals to produce easy to calculate ratings.

First use them at 4 deg. entrance angle

LDR4: Mid-to-Long distance rating = 1 x [RA at 0.2°] + 5 x [RA at 0.5°]
SDR4: Mid-to-Short distance rating = 5 x [RA at 0.5°] + 13 x [RA at 1.0°]
(These RAs are at 4° entrance angle.)

Examples using existing ASTM Types & XI:

Type I: LDR4 = 220; SDR4 = unspecified, but it's around 360
Type II: LDR4 = 390; SDR4 = unspecified, but it's around 480
Type III: LDR4 = 725; SDR4 = unspecified, but it's around 680
Type IV: LDR4 =1110; SDR4 = unspecified, and unspecifiable
Type V: LDR4 = 1500; SDR4 = unspecified, and unspecifiable
Type VI: LDR4 =1625; SDR4 = unspecified, and unspecifiable
Type VII: LDR4 = 1950; SDR4 = unspecified, and unspecifiable
Type VIE: LDR4 = 1950; SDR4 = unspecified, and unspecifiable
Type IX: LDR4 = 1580; SDR4 = 2240
Type X: LDR4 = 1560; SDR4 = unspecified, and unspecifiable
Type XI: LDR4 = 2570; SDR4 = 3560

Similarly:
LDR30: Mid-to-Long distance rating = 1 x [RA at 0.2°] + 5 x [RA at 0.5°]
SDR30: Mid-to-Short distance rating = 5 x [RA at 0.5°] + 13 x [RA at 1.0°]
(These RAs are at 30° entrance angle.)

Examples using existing ASTM Types & XI:

Type I: LDR30 = 105; SDR30 = unspecified, but it's around 230 Type
II: LDR30 = 200; SDR30 = unspecified, but it's around 320 Type III:
LDR30 = 475; SDR30 = unspecified, but it's around 490 Type IV:
LDR30 = 530; SDR30 = unspecified, and unspecifiable Type V:
LDR30 = 775; SDR30 = unspecified, and unspecifiable Type VI:
LDR30 = 960; SDR30 = unspecified, and unspecifiable Type VII:
LDR30 = 1105; SDR30 = unspecified, and unspecifiable Type VIII:
LDR30 = 900; SDR30 = unspecified, and unspecifiable Type IX:
LDR30 = 890; SDR30 = 1260
Type X: LDR30 = 780; SDR30 = unspecified, and unspecifiable
Type XI: LDR30 = 960; SDR30 = 1335

Finally, we can average the 4° and 30° entrance angle ratings if we like to make LDR simpliciter and SDR simpliciter.

Examples using existing ASTM Types & XI:

Type I: LDR =163; SDR = unspecified, but it's around 295
Type II: LDR = 295; SDR = unspecified, but it's around 400
Type III: LDR = 600; SDR = unspecified, but it's around 585
Type IV: LDR = 820; SDR = unspecified, and unspecifiable
Type V: LDR = 1138; SDR = unspecified, and unspecifiable
Type VI: LDR = 1125; SDR = unspecified, and unspecifiable
Type VII: LDR = 1528; SDR = unspecified, and unspecifiable
Type VIII: LDR = 1425; SDR = unspecified, and unspecifiable
Type IX: LDR = 1235; SDR = 1750
Type X: LDR = 1170; SDR = unspecified, and unspecifiable
Type XI: LDR = 1765; SDR = 2448

The magic coefficients in all the above are 1,5, 13. They result from choice of headlight distribution and sign position and could be debated.

The resultant ratings LDR are calculated from the same data as your grade-determining averages, and the results aren't all that different from yours:

Using LDR: Type II is 1.8
x Type I Type III is 3.7 x
Type I Type IV is 5.0 x
Type I Type V is 7.0 x
Type I Type VI is 6.9 x
Type I Type VII is 9.4 x
Type I Type VIII is 8.8 x
Type I Type IX is 7.6 x
Type I Type X is 7.2 x
Type I Type XI is 10.9 x
Type I

Using your method: Type
II is 1.9 x Type I Type III
is 3.9 x Type I Type TV is
5.2 x Type I Type V is 9.3
x Type I Type VI is 7.0 x
Type I

Type VII is 10.8 x Type I Type VIII is 9.7 * Type I Type IX is 6.8 x Type I Type X is 7.9 x Type I Type XI is 9.3 x Type I

The engineer gets an SDR rating in addition to an LDR rating.
By SDR:
Type II is about 1.4 x Type I
Type III is about 2.0 x Type I
Type IX is about 5.9 x Type I
Type XI is about 8.3 x Type I

Motion to find this Negative Not Persuasive

We move to find this negative not-persuasive for the following reasons:

1. There is a need for a new type. An independent study conducted by the Arizona Department of Transportation that compared high performing prismatic sheeting materials in a side-by-side presentation, although not entirely comprehensive in its scope, found that material meeting the proposed Type XI specification was judged better than the others tested. Numerous users have also conducted evaluations for which similar results have been reported.
2. Arguments regarding the redesign of the standard to add guidance for clarity or make it more based on user needs are beyond the scope of this ballot item and are being addressed elsewhere. In the meantime we need to keep the standard current.
3. Arguments to redesign the standard using alternative observation angles are not justified and are beyond the scope of this ballot.
4. Inappropriate reference to ASTM standards is beyond the scope of this ballot.
5. The intellectual property claims at issue (those that relate to the ASTM performance standards) have been withdrawn from consideration before the U.S. Patent and Trademark Office.

Motion Passed 48-15-15

Negative Vote #3 - Drew Buoni, Avery Dennison

I am voting negative on the ballot to add a Type 11 sheeting to ASTM D-4956 for two different reasons:

Reason #1: Task Group work is incomplete.

Although I was unable to attend the June, 2005 ASTM meeting, it is my understanding that the Task Group on Retroreflective Sheeting took an initial look at a possible Type 11 specification. Further, it is my understanding that numerous issues and arguments were raised at that meeting, and at that time, the Task Group unofficially voted against adding a Type 11 specification until the various issues could be addressed. At this time,

however, none of these issues appear to have been addressed, but there is now an official Sub-Committee Ballot proposing the very same specification that was previously voted against at Task Group. As such, the Ballot at hand should be voted down and withdrawn until such time as the issues raised during Task Group have fully been addressed.

Reason #2: An alternative specification for a Type 11 sheeting will eliminate both future confusion and the unnecessary proliferation of additional sheeting Types within ASTM.

Many people on this Sub-Committee will remember the confusion caused in the market place five years ago when ASTM D-4956 originally added Type 7, 8, and 9. Although all of these specifications represented a significant boost in performance compared to Type 3 High Intensity sheeting, they were all slightly unique and different in their own independent ways. Generally speaking, Type 7 and 8 created a new class of sheetings with strong performance at medium and long distances. Type 9 excelled at shorter distances. As a result of ASTM adding three new specifications for micro-prismatic sheeting based largely on manufacturer product specifications, each State, City, and County needed to make a decision on how to implement these new specifications. With only some guidance from the various reflective manufacturers, there was a sizeable amount of confusion in the market. Some States combined all three into a single specification. Others, selected only one of the three specifications. In the end, end-users were not truly served by adding three product specifications to D-4956.

Although I am generally against adding a Type 11 specification to ASTM because many of the issues raised at Task Group have not been addressed, there is one fairly strong reason to add *a* Type 11 specification (although *not the proposed* Type 11 specification). The general retro-reflectivity attributes suggested by the ballot combine most of the performance attributes of Type 7, 8, and 9 (and now 10) into a single ASTM Type. This is appealing because it will eliminate much of the previous confusion by adding a single category to capture most aspects of the existing ASTM micro-prismatic sheeting Types. Unfortunately, the specific proposal for a Type 11 sheeting will result in a proprietary specification for a single manufacturer and should not be adopted. An alternative specification is needed (as outlined below).

Many members on this Sub-Committee may not realize it, but the product (DG3) outlined by the current ASTM ballot is a heavily patented and proprietary product. 3M Company has filed and received many patents on this product. As such, ***adopting the current Type 11 proposal will result in a proprietary and monopolistic position for 3M.*** Consider the following claims in a recent 3M patent application (Reference US 20040174601A1), which is just one of many 3M patents on their DG3 product.

> Claim 41: Retroreflective sheeting comprising an array of preferred geometry cube corner elements that exhibits an average brightness at 0° and 90° orientation according to ASTM D-4956-01a of at least 375 cd/lx/m2 for an entrance angle of –4° and an observation angle of 0.5°.
>
> Claim 42: The retroreflective sheeting of Claim 41 wherein the average brightness is at least 400 cd/lx/m2.

By incorporating the performance levels of 375 and 400 cd/lx/m2, these claims essentially cover the proposed ASTM ballot. This would essentially block other manufacturers from producing a Type 11 product. 3M Company will argue that these patents only represent a single technology or single method to create this new class of sheetings. And while it is true that other technologies may exist, the fact is that 3M Company has so many patents surrounding the DG3 product, it will be nearly impossible for any other manufacturer to achieve the retroreflectivity performance outlined by the existing Type 11 proposal.

This Sub-Committee is again at a cross roads. If it votes to add the proposed Type 11 specification to D-4956, it will open the door for additional product specifications in the future as no other reflective manufacturers will be able to produce a Type 11 sheeting. Within a few years, there will probably be Type 12 and Type 13 specifications added to ASTM. This will bring us to back to the same positions as when Types 7, 8, and 9 were originally adopted. An alternative path is needed.

Listed below is an alternative retro-reflectivity table for a Type 11 sheeting that will allow competition, but will still achieve the goals of combining the performance attributes of Types 7, 8, 9, and 10 sheetings:

- By incorporating the same 1.0 observation angle values of Type 9 sheeting, it incorporates strong short-distance performance characteristics at both –4 and 30 entrance angles.
- It provides a boost of nearly 25% at –4 entrance angle and 0.5 observation angle to provide stronger performance at short-to-medium distances.
- The long distance performance at –4 entrance angle and 0.2 observation is more representative of the long distance performance provided by Types 7, 8, and 10.

	White	Yellow	Orange	Green	Red	Blue	Brown	FYG	FY	FO
0.1/-4	750	560	280	75	135	37	22	600	450	225
0.1/30	370	280	140	37	74	17	11	300	220	110
0.2/-4	525	395	195	52	95	30	16	420	315	155
0.2/30	215	162	82	22	43	10	6.5	170	130	65
0.5/-4	310	230	116	31	56	18	9.3	245	185	93
0.5/30	135	100	50	14	27	6	4	110	81	41
1.0/-4	80	60	30	8.0	16	3.6	2.4	64	48	24
1.0/30	45	34	17	4.5	9	2.0	1.3	36	27	14

Overall, this alternative specification is a small departure from the existing proposal, but will still achieve the goals of providing an open, competitive market and a specification combining the performance attributes of Types 7, 8, 9, and 10.

Motion to find this Negative Not Persuasive

We move to find this negative not-persuasive for the following reasons:

1. Voting procedures were conducted in accordance with ASTM procedures.

2. The claims at issue (those that relate to the ASTM performance standards) have been withdrawn from consideration before the U.S. Patent and Trademark Office.

3. Alternate proposals with lower minimums have not been justified.

Motion Passed 49-11-18

Negative Vote #4 - Mark Kleinschmit, Avery Dennison

My negative is composed of the following parts:

1. I do not think that adequate information/data has been provided to justify a new, sole-source Type.
2. I do not think that the current test geometries properly characterize DG^3
3. The actual performance of DG^3 is not really different from another product that is in the market and any Type XI proposal should accommodate both products.

Sole-source Types do not benefit users and cannot be justified, unless a true safety benefit is demonstrated.

A new Type based upon a single product creates the opportunity for intentional or unintentional sole-source specifications. If someone wishes to only purchase a single, specific product – they may do so. They simply specify the product (and supplier) by name. We heard an example in Reno of a DOT that wishes to purchase DG^3, and described that they need a Type XI added to D4956 to do so. This is not in accordance with federal procurement regulations. 49 CFR 18.36 requires that a purchaser justify their sole-source spec. It is only reasonable that we, as writers of a standard primarily used in purchasing agreements, apply the same criteria: we must see compelling evidence of a safety benefit.

It was also confirmed by multiple DOT officials in Reno that if ASTM D4956 adopts the current Type XI, few purchasers will recognize Type XI as a sole-source specification. This obviously creates the opportunity for deceptive purchasing practices. There is no good reason why we should create this opportunity for confusion. Also, as taxpayers, we should all be concerned when competitive price-pressure is removed from governmental purchasing decisions.

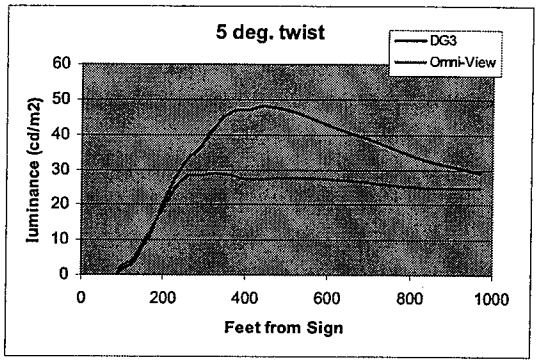
There has been no data presented that the values on the proposed table represent any particularly necessary or special level of performance. The only data that has been provided shows that DG^3 is *perceptibly* different from other prismatics. This must not be misinterpreted as a measure of performance. A 10% difference in brightness may be discernable, but certainly does not constitute a meaningful safety benefit to the driver.

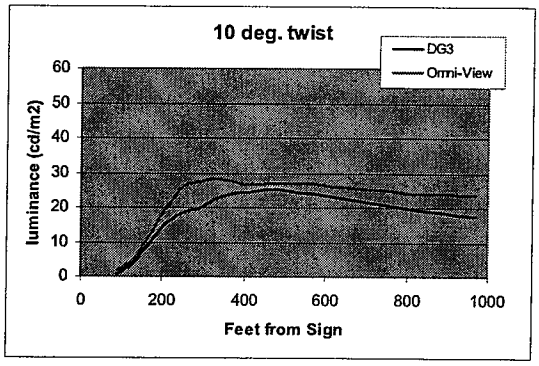
Remedy: If evidence of a compelling safety benefit unique to DG^3 is presented and accepted by the subcommittee, then the existing table can be reconsidered. Or the table should be modified to accommodate additional products, which prevents the creation of a sole-source specification.

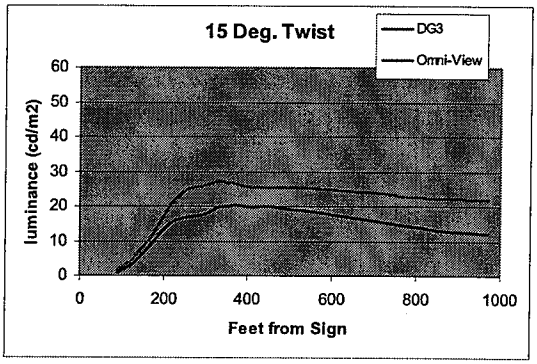
DG^3 performance is not well represented by the current test geometries

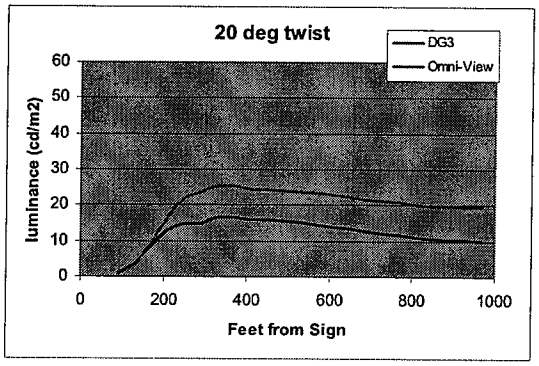
In a sense, DG3 is a "narrow angle" prismatic material. I have attached a number of ERGO drive-through graphs comparing DG^3 with Avery Dennison's Omni-View below. (ERGO settings: 12 feet off right edge line, 10 feet high, twist away from roadway (per MUTCD recommendations), UMTRI lighttruck/van, umtri25v headlight) With a sign twist of 5 deg., DG^3 is performing well. But by increasing the twist to 10, 15, 20 deg, DG^3 has surprising performance fall-off.
If DG^3 is oriented (according to the product data bulletin) to maximize entrance angle performance, the two products still converge to very similar performance. The graphs also show that DG^3 peak luminance is also reduced by 20% if it is rotated 90 degrees. We have visually confirmed these simulation results with actual signs, vehicles and drivers.

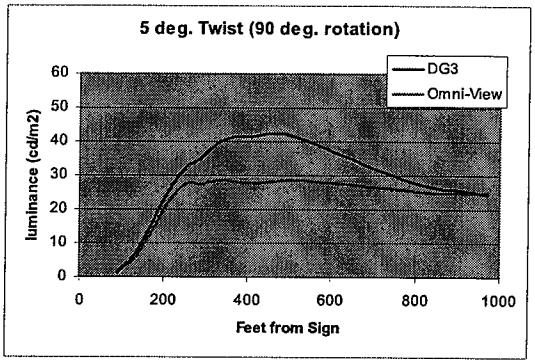
In D4956 we have chosen to only specify two entrance angles because we expect that the sheetings will behave in a predictable way between them.We also measure sheeting at 0

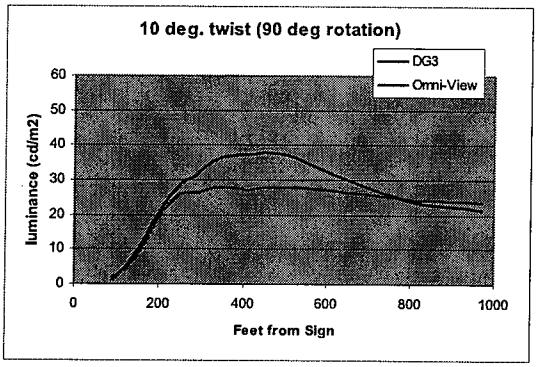


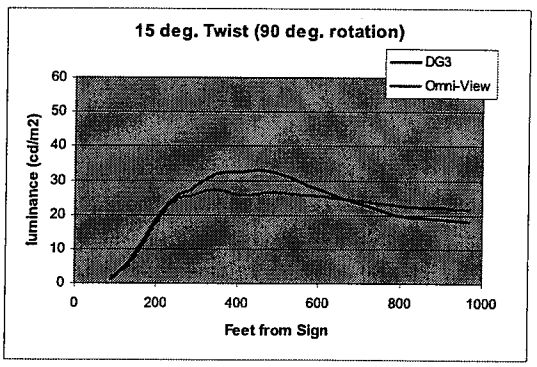


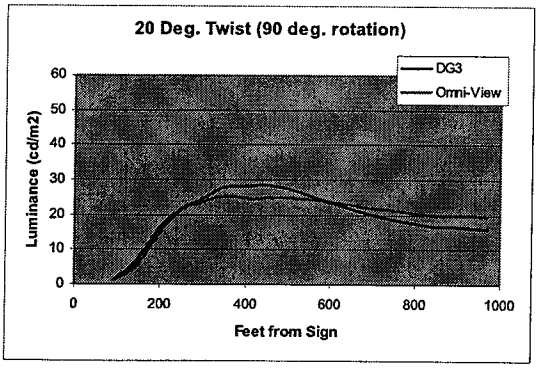












and 90 deg. and then average. But we don't expect that a sheeting will have a 20% swing

in performance, or significantly different entrance angle fall-off if it is mounted in one way or another.

In summary, DG^3 exhibits design peculiarities that are not well described by the existing test geometries, particularly the mounting dependent behavior. An end user would not anticipate such a change in performance. And we do care how bright a road sign is as it is twisted.

Remedy: If DG^3 receives its own Type (the balloted Type XI), then additional information must be provided to the users. Text describing the strong orientation sensitivity and its repercussions on product performance must be included in the product description. The subcommittee must also consider including other entrance angle requirements, or at least define what a "predictable" entrance angle fall-off should look like, so we can determine now, and in the future, when additional entrance angles need to be specified.

Grouping Similar Products

Obs. Ang.	Ent. Ang.	Ballot XI	Avery XI	Difference
0.1	-4	860	750	12.8%
0.1	30	320	370	-15.6%
0.2	-4	570	525	7.9%
0.2	30	210	215	-2.4%
0.5	-4	400	310	22.5%
0.5	30	150	135	10.0%
1	-4	120	80	33.3%
1	30	45	45	0.0%
			Average:	**8.6%**

I have submitted a proposal for a Type XI based upon the performance of Avery Dennison's new product, Omni-View. The commonality between the two products is that both materials provide 0.2 Observation Angle (OA) performance that is similar to Type X, both feature increased 0.5 OA performance, and retain or exceed the 1.0 OA performance of Type IX. Comparing the two proposed tables, the overall average difference is only 8.6%. This is similar to the change that the subcommittee earlier imposed on the proposal by Nippon Carbide on Type X to accommodate a product for 3M. But this is only looking at a very select set of measurements. The real question of similar performance must come from evaluation of materials on a roadway. The graphs and a real viewing tell the real story – that DG^3 and Omni-View have a lot more in common than there is a difference.

Remedy: If the committee wishes to add a new Type to represent these new long, medium and short distance sheetings, grouping these two products into a similar Type would make sense, and would add value to D4956.

Motion to find this Negative Not Persuasive

An independent study conducted by the Arizona Department of Transportation that compared high performing prismatic sheeting materials in a side-by-side presentation, although not entirely comprehensive in its scope, found that material meeting the proposed Type XI specification was judged better than the others tested. Numerous users have also conducted evaluations for which similar results have been reported.

Federal guidelines on proprietary products pertain to the use of those products, not to the establishment of specifications for those products.

Changing protocols with respect to rotation angle and entrance angle conventions are beyond the scope of this ballot and are being addressed elsewhere. In the meantime, we need to keep the standard current.

Motion Passed 48-15-15

Negative Vote #5 - Steven Chapman, Avery Dennison

I am voting negative on subcommittee ballot item 2 to revise D 4956-05 to add a new Type – Type XI. I feel that the performance difference between the proposed Type XI and the existing Type IX is not large enough to warrant a new type. I would like to support this assertion as follows:

1) An historical argument can be made by looking at existing types in D4956. It is reasonable to expect at least a 2x increase in a new type. The proposed Type XI specification does not achieve a 2x increase. It only achieves 1.56x.
2) This 1.56x increase is only achieved at the –4° test points. There is no significant increase at 30°. The average increase is then 1.29x.

Dennis Couzin, prior to his resignation from D04.38, made these points well in a draft negative which I am including below. I find myself in agreement with Dennis, when he says: "It does not serve D4956 well to introduce new Types which differ from old Types over limited sets of test points by substandard steps. The more limited the set, the greater step difference should be demanded."

I do not see a remedy to the small performance difference between Type IX and the proposed Type XI. The solution is to not add the proposed Type XI.

Negative on Item 2 to revise D4956 to add new Type XI.

This negative is based on there being too small a performance difference between the proposed Type XI and the approved Type IX. What should count as enough difference enough can be deduced from a study of many Types already in D4956.

First sort D4956 permanent sign sheeting Types into these three groups:

characterized at 0.2° and 0.5° observation angles		characterized at 0.5° and 1.0° observation angles
based on beaded	based on prismatic	
I, II, III	IV, VII, VIII, X	IX

The following table lays out the first group of Types.

	0.2°/-4°	0.2°/30°	0.5°/-4°	0.5°/30°
I	70	30	30	15
II	140	60	50	28
III	250	150	95	65

The next table shows the Type-to-Type steps for this group.

	0.2°/-4°	0.2°/30°	0.5°/-4°	0.5°/30°
I → II	2.00×	2.00×	1.67×	1.87×
II → III	1.79×	2.50×	1.90×	2.32×

The next table shows column averages.

	0.2°/-4°	0.2°/30°	0.5°/-4°	0.5°/30°
average step	1.89×	2.25×	1.78×	2.09×

The grand average step for the first group is 2.01×.

Within the second group there is an embarrassing tangle around VII, VIII, X. D04.38 has many times expressed its contrition over differentiating VII from VIII, and lately the same over modifying the original Nippon Carbide proposed values for X. Let's accept that D04.38 made a Mess with VII, VIII, X, and try to substitute a Type M to cover the mess. Eventually there may be a replacement using the leasts between VII, VIII, X_{NC}, but here we'll make Type M the average of VII, VIII, X_{NC} as this better expresses the historical level shot at by D04.38. The second group of IV, VII, VIII, X is reduced to IV, M

The following table lays out the second group of Types.

	0.2°/-4°	0.2°/30°	0.5°/-4°	0.5°/30°
IV	360	170	150	72
M	683	352	243	123

As before we find steps and an average.

	0.2°/-4°	0.2°/30°	0.5°/-4°	0.5°/30°
IV → M	1.90×	2.07×	1.62×	1.71×

The grand average step for the second group is 1.83×.

According to the above, D4956 includes two Type hierarchies each with healthy average step sizes. If the "M" problem were fixed, D4956 would be respectable Standard.

The third group has just Type IX. D4956 describes Type IX as:

> 4.2.9 A very-high-intensity retroreflective sheeting having highest retroreflectivity characteristics at short road distances as determined by the R_A values of Table 3 at 1° observation angle.

Compare the balloted description of new Type XI:

> 4.2.11 A super-high efficiency retroreflective sheeting having highest retroreflective characteristics at medium and short road distances as determined by the R_A values of Table 5 at 0.5° and 1.0° observation angles.

The difference between the two descriptions is unacceptable. Type IX and new Type XI have almost identical observation angularity. They both have their highest retroreflectivity characteristics at short distance, or they both have it at medium and short distance, or some other compromise. I prefer the description in the ballot.

Now see what happens when we try to group new XI with IX.
The following table lays out the third group.

	0.5°/-4°	0.5°/30°	1.0°/-4°	1.0°/30°
IX	240	135	80	45
new XI	400	150	120	45

The next table shows the Type-to-Type steps.

	0.5°/-4°	0.5°/30°	1.0°/-4°	1.0°/30°
IX → new XI	1.67×	1.11×	1.50×	1.00×

The average step size for the group is just 1.32×.

This must be compared with the average step sizes 2.01× and 1.83× of the other groups. To accept the balloted Type XI is to accept a step size that is hardly a third of what gives D4956 Types a chance of decency.

I've tried to find a way around this problem of the IX → XI Type step size being too small for D4956. The new 3M DG3 sheeting represents the end of the line in sheeting

efficiency development. We can never raise the XI numbers enough to have 1.83× steps over all the IX numbers.

We can't lower the R_A numbers for Type IX, because users have become used to Type IX.

The IX → XI step strongly resembles a III → IV step which was avoided in the above groupings.

	0.2°/-4°	0.2°/30°	0.5°/-4°	0.5°/30°
III → IV	1.44×	1.13×	1.58×	1.11×

IV was not introduced as a performance step over III, but as the start of a new group based on a new technology. The new 3M DG3 sheeting arguably represents a technological change, and likewise one which enhances -4° performance without enhancing 30°. Try to ungroup IX and XI. This requires changing 2.9.11 to something like:

> 2.9.11rev A super-high efficiency retroreflective sheeting having [its] highest retroreflective characteristics for small entrance angle applications at medium and short road distances, as determined by the R_A values of Table 5 at 0.5° and 1.0° observation angles at -4° entrance angle.

This reduces but does not remove the problem. It does not serve D4956 well to introduce new Types which differ from old Types over limited sets of test points by substandard steps. *The more limited the set, the greater step difference should be demanded.* New Type XI is practically the same as IX at 30° test points and about 1.56× at the -4° test points. Compare the D4956 beaded sheeting heirarchy with 2.01× step size averaged over *all* test points and also a D4956 prismatic sheeting heirarchy with 1.83× step size averaged over *all* test points.

I would demand a 2× step over a significant subset of test points versus all other Types from any new Type. There is some explanation below why sheeting grading requires large step sizes.

I expect that some recent human factors research will be cited against my negative. The research showed a significant performance difference between 3M VIP sheeting (which is a Type IX) and 3M DG3 sheeting (which would be a Type XI). I remind the Subcommittee of two details.

(1) A performance difference between two materials that is enough to be highly significant for one driver in one vehicle, and even for every driver in every vehicle, might not be enough to warrant a Type difference. The reason is exactly that drivers and vehicles are different, and a Type difference should be enough so most drivers in most vehicles will find a sign made with the one material significantly better than most drivers in most vehicles find the other material. This seemingly contradictory logic will become

clear with an example. Suppose the material on sign A has all its R_A values 1.5× those of the material on sign B. This will make a definite visible difference between A and B, which every driver of every vehicle should notice in every scenario. Now consider just one variable factor, headlight brightness. UMTRI publishes headlight statistics at 25th, 50th, and 75th percentiles. Their 75th percentile headlights shine about 1.8× as much light on a sign as their 25th percentile headlights. This implies that about 30% of drivers are seeing sign B as brighter than about 30% of drivers are seeing sign A. This is not what specifiers want when they specify the higher Type material of A. So 1.5× is not enough to warrant a Type difference in view of the confounding factors such as headlights. The conventional wisdom in Europe is that 3.16× is required for a "class" difference, as they call it. Jim Roth used factors of 2× in his proposals. You need a hefty step so specifiers can be sure of what they're doing.

(2) We are balloting revisions to D4956 Types. Types are not sheetings. Sometimes sheetings do things that their Type descriptions cannot cover. For example, you might imagine two sheetings that are alike at both 0.5° and 1.0° but very unequal at 0.75°. The one that's higher at 0.75° could look quite a bit better in a road scenario. This is just a hypothetical example, but it is a warning to base our decisions about substantial differences between Types on the D4956 Type descriptions, nothing else.

Motion to find this Negative Not Persuasive

We move to find this negative not-persuasive for the following reasons:

An independent study conducted by the Arizona Department of Transportation that compared high performing prismatic sheeting materials in a side-by-side presentation, although not entirely comprehensive in its scope, found that material meeting the proposed Type XI specification was judged better than the others tested. Numerous users have also conducted evaluations for which similar results have been reported. Alternate proposals for revising the standard in alignment with mathematical models are beyond the scope of this ballot and have not been justified. In the meantime we need to keep the standard current.

Motion Passed 47-16-15

Negative Vote #6 - Norman Yamaguchi, Novabrite

Section 4. There is absolutely no need to add another Type sheeting. Ten is already too many. Less Types are needed, not more.

Motion to find this Negative Not Persuasive

An independent study conducted by the Arizona Department of Transportation that compared high performing prismatic sheeting materials in a side-by-side presentation, although not entirely comprehensive in its scope, found that material meeting the proposed Type XI specification was judged better than the others tested. Numerous users have also conducted evaluations for which similar results have been reported.

Arguments regarding the redesign of the standard to make it simpler, to reduce the number of types or to add guidance are beyond the scope of this ballot item and are being addressed elsewhere. In the meantime we need to keep the standard current.

Motion Passed 52-10-16

Negative Vote #7 - Hal Shapiro, Avery Dennison

I do not feel as if this specification should be written in this manner. It allows for a single source for the type XI portion of the specification.

Motion to find this Negative Not Persuasive

The elimination of sole-source specifications is beyond the scope of this ballot.

Motion Passed 50-11-17

Negative Vote #8 - Ken Udding, The Retroreflective Advisory

Background for Rationale of Negative: The original glass bead sheeting materials (Type I, II, and III) are each produced and sold by multiple manufacturers. The products of the different manufacturers are not identical but are typically well within the specification and are used interchangeably. Each of them was first produced by one manufacturer but others were able to duplicate the composite construction of each type (while using the common characteristics of spherical glass beads to create the optical system) and produced near-identical material.

Note: In the discussion below "performance" of different materials is compared using the mean of the differences in specification values for observation angles of 0.2 and 0.5 degrees (at only -4 degrees Entrance angle). This is for simplicity in discussion and does not suggest that other differences (most notably, higher values at 1.0) do not also merit consideration.

The performance ratio from Type 1 to Type II is 84% and again, from Type II to Type III is also 84%.

The development of prismatic materials provided a technology which could produce not only even higher values than the best of the glass bead but the geometric design options available in the individual cube-corner prisms, made possible a variety of observation angle performances which might be utilized to tailor the sheeting performance to perceived needs. However, substantial financial investment and long tool-up time is required to create a new prismatic material and no manufacturer has elected to replicate the earlier product of another; patents being but one consideration.

So we have at least seven known variations in specification performance for prismatic materials, and while Type IV is only 56% better than the best glass bead (Type III) and the first prismatic, Type VII, exceeds IV by 84 %, subsequent "Types" (designated and/or proposed) seek to have far lesser differences (or the subsequently introduced 1.0 degree value) recognized as a type.

Since the failure of the attempt to create a single type spec of VII, VIII and IX several years ago, no coordinated "system" of numerical difference has evolved. Instead, the cry of "unique differences" has permeated arguments to add yet another type.

Probably everyone at this committee is aware that human visual differences occur on a logarithmic scale so photometric test value differences are seen by the eye as effectively less. There is even some support for the idea that differences need to be in the 3:1 range (300%) to be significant. Certainly, differences of 25% or even 50% are, by themselves, insufficient to establish meaningful differences in performance.

Basis for Negative: I have previously expressed the opinion that, if the prior rationale to establish separate Types VII, VIII, and IX and subsequently to add Type X, were to be applied here, that the proposal for Type XI would have to be granted, and to further allow yet-to-be-submitted Types XII, XIII, etc. The appearance of another material "similar" to the proposed Type XI emphasizes the morass of specifications being created.

I propose that the subcommittee review specification values for all prismatic materials (retaining glass bead specifications unchanged) and create a stepped set of values, creating a limited number of "Types" into which both current and future materials can fit with the most logical arrangement. (This may evolve from the work of Jim Roth although this proposal does not necessarily here endorse the form of his latest proposal.).

Note: I do not favor any "sub-types" (such as "IX-A" for example). They still create another "Type".

Comment: I do believe that D-4956 in its current format, but modified as proposed, is basically a "QC" document and not a "design" or true "performance" document. Since it is cited by so many national, state and local specifications, it should be retained (and even updated when required) even well after any performance specification –based on "drivers needs" - is created and issued (desirable but well in the future)/

Motion to find this Negative Not Persuasive

We move to find this negative not-persuasive for the following reasons:

There is a need for a new type. An independent study conducted by the Arizona Department of Transportation that compared high performing prismatic sheeting materials in a side-by-side presentation, although not entirely comprehensive in its scope, found that material meeting the proposed Type XI specification was judged better than the others tested. Numerous users have also conducted evaluations for which similar results have been reported. Arguments regarding the redesign of the standard to make it more logical in terms of material groups are beyond the scope of this ballot item and are being addressed elsewhere. In the meantime we need to keep the standard current.

Motion Passed 49-14-15

Negative Vote #9 - Bob Lightle, Rocal

Section 4.2.11 and related sections should not be passed because:

The standard is very confusing now.
Needs of Drivers have not been established.
Standard is not in synch with other international standards
Types are manufacturers product Specifications, not Standards

I do not believe that we should approve the proposed ballot section 4.2.11 for the following reasons:

1. There are too many types now in ASTM D 4956-05 and it makes it very confusing within the industry. Several states and other governmental end users are now grouping several types in their specifications as equal, thus defeating the purpose set forth in the 1995 passage of the United States "Technology Transfer and Advancement Act (Public Law 104-113)". The Law requires government agencies to use privately developed standards whenever possible, saving taxpayers millions of dollars in formerly duplicative standards development efforts[1]. This detail is a major principal of ASTM International - . . . standards are "voluntary" in the sense of their use is not mandated by ASTM. However, governmental regulators often give voluntary standards the force of law by citing them in laws, regulations, and codes[2]. The fact that these governmental agencies, with the responsibility for spending tax dollars wisely, are forced to prepare their own specifications through grouping types of the ASTM standard indicates D 4956 is

not meeting the
responsibility entrusted to it by our elected officials.

The past four types and the proposed type in this standard appear to be manufacturer's product specifications, not industry standards. Reviewing other retroreflective standards in Volume 04.03 under Road and Pavement Materials, the Reflective Pavement marker specifications (D 4280 and D 4383) has one type each listed for retroreflective while the Preformed Pavement Tape (D 4585) have two types listed.

Highway signs other component is substrate, usually aluminum. Most states specifications for highway signs also refer to both the aluminum specification and the aluminum treatment (Chromate) specifications.

ASTM standards B 209 and B 221 both referring to aluminum specifications have scores of types listed. These standards use the criteria established by "The Aluminum Association" an association of aluminum producers. According to Alcoa Aluminum less than ten percent of the types listed are used in the industry, the others have been established over the years for whatever reason a member desires, but seldom used. Once established, they are not reviewed and remain in place even though no longer produced. These standards were manufacturers' product specifications instead of industry standards. Within the highway industry only three or four types are used and none of these are patented by performance, characteristics or manufacturing processes.

Contrary to that is ASTM Standard B 449 for Chromates on Aluminum which lists the end results and four classes. It identifies the needs of the industry without being overly complex.

2. Definite needs for highway drivers have not been established. Research projects have been
performed, but most conclusions have indicated types VII through X perform similarly to drivers.
Since these types are based upon manufacturers' product specifications, design standards by sign
type have not yet been determined by reflective levels outside of manufacturers' products.
Defining research based upon drivers needs should be completed before further changes are
made.

3. ASTM is an international committee, but other parts of the world do not have nearly as many
types listed in their standards. The European Union only has three or four specified.

4. Establishing an ASTM standard type around a single manufacturer's product specification
increases chances of shortages and disruptions to industry and the traveling public if problems
arise with that manufacturer. Currently, we were quoted on materials listed in the

proposed ballot
by the manufacturer, but told after we received the bid and award, that the product could not be
delivered due to shortages and limited capacities. The manufacturer indicated only limited
distribution was available due to inability the produce demand, and could not tell us when full
distribution would be available. Standards broad enough for several producers' products reduces
chances for disruptions within the industry.

5. It appears all retroreflective sheeting manufacturers' on the committee have acted to promote
their own agenda by developing types around product specifications, instead of what is good for
all users of the product including drivers and taxpayers. The task force needs to determine if it
wants to become an association for reflective sheeting manufacturers or a serious standard setting
committee that serves the entire industry, not just the producers.

6. If any buyer believes the product in the ballot is the only one that will meet its needs, most
governmental or private agencies have provisions for justifying and purchasing non standard
products, and the manufacturer's product specification may be used. To rush a standard without
proper research and discussion of other product proposals to meet a few users perceived needs,
when alternative procedures are in place, is unwise.

If the task force determines that new standards need to be implemented and that a new type is necessary, then the performance and criteria should be identified around the driver and all manufacturers products available, reviewed with the goal of a common standard meeting the established needs.

Motion to find this Negative Not Persuasive

There is a need for a new type. An independent study conducted by the Arizona Department of Transportation that compared high performing prismatic sheeting materials in a side-by-side presentation, although not entirely comprehensive in its scope, found that material meeting the proposed Type XI specification was judged better than the others tested. Numerous users have also conducted evaluations for which similar results have been reported. Arguments regarding the redesign of the standard to make it simpler, reduce the number of choices available, render it more needs'-based or less prone to issues affecting the source of supply are beyond the scope of this ballot. Some of these issues are being addressed elsewhere. In the meantime, including this type in D4956 benefits users of the standard by keeping the standard current.

Motion Passed 49-13-16

Negative Vote #10 - Timothy Wade, Potters Industries

There are already too many types in this standard.

Motion to find this Negative Not Persuasive

An independent study conducted by the Arizona Department of Transportation that compared high performing prismatic sheeting materials in a side-by-side presentation, although not entirely comprehensive in its scope, found that material meeting the proposed Type XI specification was judged better than the others tested. Numerous users have also conducted evaluations for which similar results have been reported.

Arguments regarding the redesign of the standard to reduce the number of types are beyond the scope of this ballot item and are being addressed elsewhere. In the meantime we need to keep the standard current.

Motion Passed 52-10-16

Negative Vote #11 - Jim Roth, ODOT

I am voting negative on this ballot issue, since I am not convinced that the creation of a new type is justified. The impetus for the establishment of Type XI is based on the argument that the 3M company needs a method to identify their new DG3 material for marketing purposes. To establish a new type on this basis will result in a type with only one product conforming to the type. This is a bad idea, because it can create the illusion of a competitive environment to the casual user of the specification, when in reality, a proprietary condition exists. The only real beneficiary of this type of arrangement is for the company producing the proprietary product. I think we can do better than this.

When Types VII, VIII and IX were created, each represented a single, commercially available, material. In retrospect, we could have done better back then, but felt a need to get something in place to address these new materials, which were clearly much brighter that the existing Types III and IV. Coefficients of retroreflection were double and even triple the values for Types III and IV. There were concerns raised at the time about the wisdom of creating Types VII, VIII and IX, and it was largely understood that this would be an interim measure to get something on the books, with the intent of fixing it at a later time. Subsequent attempts to improve the situation were met with resistance, such that no changes have ever been made to the photometric values for these types. This experience exemplifies the need to move cautiously now, as we consider creating yet another type, as these actions will be difficult, or impossible, to undo later.

Type X was recently added to the specification, based primarily on the prismatic sheeting of Nippon Carbide. It was argued by the 3M company that creating a new type around only one product was a bad idea, even though we had done just that in the creation of

Types VII, VIII and IX. The task group agreed with the arguments presented by 3M, and pushed the photometric numbers downward, so that the Type X designation would cover not only the Nippon Carbide sheeting, but also one under development by 3M.

Another recent development in the specification was the adjustment of the photometric values for Types IV and VI to reflect current marketplace. This action recognized that photometric values for the types need not be static, but can be revised as necessary as available products are improved upon.

The 3M company has recently indicated their intent to phase out the VIP sheeting sold as Type IX. The new DG3 material will effectively replace the VIP product line. In this manner, the DG3 material could be considered as an enhanced Type IX. Instead of creating a new Type XI, I believe we would be better served to simply adjust the Type IX photometric values once the VIP is phased out, to reflect current marketplace. The precedent to do this has been set with the Type IV and VI materials.

Avery Dennison has presented a counterproposal for the establishment of photometric tables for a new Type XI, to describe a new sheeting that they are producing. The task group has not yet had a chance to review this proposal, and needs to do so in the context of the current ballot. On the surface, it appears the proposed photometric values, if adopted, would achieve a competitive Type XI environment. However, the values would need to be dequirked, and I am still not convinced of the need to create a Type XI.

In summary, I am voting negative on this ballot, since I do not believe there is a need for another type. As a counterproposal, I am suggesting that the Type IX photometric values be adjusted to reflect current marketplace once the 3M VIP material is phased out, in such a manner as to provide a competitive environment for both the Avery Dennison T-9500 and 3M DG3 materials. Until such time as VIP is phased out, the VIP, DG3 and T-9500 materials can all be sold as Type IX products. Once VIP is phased out, the Type IX photometric values can be revised.

Motion to find this Negative Not Persuasive

We move to find this negative not-persuasive for the following reasons:

An independent study conducted by the Arizona Department of Transportation that compared high performing prismatic sheeting materials in a side-by-side presentation, although not entirely comprehensive in its scope, found that material meeting the proposed Type XI specification was judged better than the others tested. Numerous users have also conducted evaluations for which similar results have been reported. Arguments regarding the number of commercial products available within each type are beyond the scope of this standard. Including this type in D4956 benefits users of the standard by keeping the standard current.

Motion Passed 47-15-16

Negative Vote #12 - Kejian Huang, Avery Dennison

I am voting negatively on implementing Type XI specification because 3M DG3 product has not demonstrated its performance measured against ASTM standard.

Compared to existing triangle prismatic technology, DG3 is using a different technology that is adopting the full cube or rectangular cube design. There is no historical data to support its durability performance, more indoor and outdoor weathering data are required to demonstrate DG3 can meet ASTM weathering requirement.

Motion to find this Negative Not Persuasive

Proving conformance to accelerated weathering is not a requirement for establishing a type. Even so, accelerated weathering which in accordance with the supplemental section of the standard can be used until outdoor weathering is available, has been completed and shows conformance to the proposed requirements.

Motion Passed 52-10-16

Negative Vote #13 - Philip Lancaster, FLDOT

The proposed type XI has the same description for applications and material being microprismatic. It is recommended that the prosmatic materials be classified according to their performance and application. The classification should be based on end-user needs. The task group efforts need to be considered at this time for this purpose. The establishment of type XI should be described sufficiently enough to allow other similarly performing materials to join the classification.

Motion to find this Negative Not Persuasive

There is a need for a new type. Arguments regarding the redesign of the standard to make it more based on user needs and competitive policy are beyond the scope of this ballot item and are being addressed elsewhere. In the meantime we need to keep the standard current.

Motion Passed 49-11-18

Negative Vote #14 - Ikuo Mimura, Nippon Carbide Industries

I am voting negative for the Ballot Item 2 (D0438000305002), a proposal to add new type XI because of the following reasons.

1. Inadequate ballot procedure;

Type XI establishment was straw-balloted in Reno meeting, and ended up 8 votes in favor of a task group ballot first, 1 vote in favor of subcommittee ballot and 1 abstention.

Ignoring most task group members' concern to move to subcommittee ballot directly is violating the rule on introduction of new specification.

2. Question to Task Group Chair, Mr. Jim Roth;

I am wondering if this ballot item conforms with a rule for ballot on introduction of new specification. I would like a chair person to kindly explain all of task group members the ballot rule.

3. Did Proposer explain to Negative Comments;

In the first Ballot in Reno, there are substantial negative comments on the proposal of new type XI. I DO NOT think the proposer DID respond to these comments. The proposer should respond to these negative comments and reflect these comments to a revised second proposal. I understand the second proposal is identical to the first one. If Tom Bliss does not respond to our negative comment, Nippon Carbide request to revise Type X specification table which were proposed by Tom Bliss to originally proposed values which were proposed by Nippon carbide.

That's al

Motion to find this Negative Not Persuasive

Voting procedures were conducted in accordance with ASTM procedures. Alternative specifications proposed for existing Type X are beyond the scope of this ballot.

Motion Passed 49-12-17

Negative Vote #15 - Greg Fisher, Avery Dennison

On creation of new type XI: I do not believe that it has been demonstrated that the increase in head-on brightness offers enough of a benefit to end users to warrant the creation of a new type. Creation of new types without clear-cut functional advantages will make things unnecessarily more confusing for customers.

Motion to find this Negative Not Persuasive

An independent study conducted by the Arizona Department of Transportation that compared high performing prismatic sheeting materials in a side-by-side presentation, although not entirely comprehensive in its scope, found that material meeting the proposed Type XI specification was judged better than the others tested. Numerous users have also conducted evaluations for which similar results have been reported.

Motion Passed 48-12-18

Main Committee Ballot Item # 28

Proposed Amendment to ASTM D4956-05 to include a new Type of sheeting (Type XI)

Section 4. Classification

Current wording: ...There are ten types and five classes of retroreflective sheeting...

Proposal: ...There are eleven types and five classes of retroreflective sheeting...

Section 4.1.1 list of Typical Applications

Add: XI Highway signing, construction-zone devices, and delineators

Section 4.2.11 (add new section)

4.2.11 *Type XI* –A super-high efficiency retroreflective sheeting having highest retroreflective characteristics at medium and short road distances as determined by the R_A values of Table 5 at 0.5° and 1.0° observation angles. This sheeting is typically an unmetallized microprismatic element material. Typical applications for this material are permanent highway signing, construction zone devices, and delineators.

Table 5 (new table – all subsequent tables and their references to be renumbered)
Type XI Sheeting[A]

	White	Yellow	Orange	Green	Red	Blue	Brown	Fl. Yel/Gm	Fl. Yellow	Fl. Orange
.1/-4	860	640	320	86	170	39	26	690	520	260
.1/30	320	240	120	32	65	15	9.8	260	195	98
.2/-4	570	430	210	57	115	26	17	460	340	170
.2/30	210	160	81	22	43	9.7	6.5	170	130	64
.5/-4	400	300	150	40	80	18	12	320	240	120
.5/30	150	110	56	15	30	6.8	4.5	120	90	45
1.0/-4	120	90	45	12	24	5.4	3.6	96	72	36
1.0/30	45	34	17	4.5	9	2	1.4	36	27	14

[A] Minimum Coefficient of Retroreflection
[B] Values for 0.1° observation angle are supplementary requirements that shall only apply when specified by the purchaser in the contract or order

Section 6.1.11 (add new section)

6.1.11 *Type XI* – Minimum Coefficient of Retroreflection – Table 5; Outdoor Weathering – 36 months, see 6.4; Daytime Luminance Factor – Table 11 and Table 15; Other requirements: When sheeting is specified for construction work zone applications, the outdoor weathering shall be 12 months.

Table 16 (currently Table 15) add Type XI and change Table references as needed:

Table 16 Outdoor Weathering Photometric Requirements for All Climates

Type	Months[A]	Minimum Coefficient of Retroreflection, R_A
I	24[B]	50% of Table 6
II	36[B]	65% of Table 8
III	36[B]	80% of Table 9
IV	36[B]	80% of Table 10
V	36[B]	80% of Table 12
VI	6[B]	50% of Table 14
VII	36[B]	80% of Table 1
VIII	36[B]	80% of Table 2
IX	36[B]	80% of Table 3
X	36[B]	80% of Table 4
XI	36[B]	80% of Table 5

[A] Testing at shorter intervals may be done to gather additional information.
[B] When sheeting is specified for construction work zone applications, the outdoor weathering shall be 12 months.

Table S2.1 Add Type XI and change Table references as needed:

Table S2.1 Minimum Coefficient of Retroreflection (R_A) and Required Outdoor Exposure Times

Type	Months	Minimum Coefficient of Retroreflection (R_A)
I	12	65% of Table 6
II	12	65% of Table 8
III	12	80% of Table 9
IV	12	80% of Table 10
V	12	80% of Table 12
VI	6	50% of Table 14
VII	12	80% of Table 1
VIII	12	80% of Table 2
IX	12	80% of Table 3
X	12	80% of Table 4
XI	12	80% of Table 5

Table S3.1 Add Type XI and change Table references as needed:

Table S3.1 Exposure Times and Photometric Requirements for Artificial Accelerated Weathering

Type	Hours	Minimum Coefficient of Retroreflection (R_A)
I	1000	50% of Table 6
II	2200[A]	65% of Table 8
III	2200[A]	80% of Table 9
IV	2200[A]	80% of Table 10
V	2200	80% of Table 12
VI	250	50% of Table 14
VII	2200[A]	80% of Table 1
VIII	2200[A]	80% of Table 2
IX	2200[A]	80% of Table 3
X	2200[A]	80% of Table 4
XI	2200[A]	80% of Table 5

[A]. When sheeting is specified for construction work zone applications, the outdoor weathering shall be 500 h.