Deerfield Township, Warren County Ohio
Traffic Sign Retroreflectivity and General Maintenance Program

1. Introduction

"Retroreflectivity" refers to the property of a traffic sign to reflect light back to the driver. Retroreflective traffic signs are used to increase sign visibility at night. Maintaining sign retroreflectivity is important to promote nighttime traffic safety.

In January 2008, the Federal Highway Administration (FHWA) enacted new requirements for maintaining minimum levels of retroreflectivity for traffic signs. These requirements were established through the national Manual on Uniform Traffic Control Devices (MUTCD), and apply to all agencies that maintain roadways open to public travel. The MUTCD implementation resulted from a final rule published in the Federal Register on December 21, 2007; and amendments from August 31, 2011.

The Ohio Manual of Uniform Traffic Control Devices (OMUTCD) is required to be in substantial conformance with the national MUTCD, and must incorporate new requirements within two years. Revision 1 of the OMUTCD 2005 Edition, effective January 2010, introduced a new section (2A.09) that sets forth the traffic sign retroreflectivity requirements for Ohio.

The responsibility for the design, placement, operation, maintenance, and uniformity of traffic control devices rests with the public agency or the official having jurisdiction. Per Section 4511.11 of the Ohio Revised Code, local authorities shall place and maintain traffic control devices in accordance with the OMUTCD.

1.1 Implementation Requirements

The amended final rule from FHWA established compliance dates for the new retroreflectivity standards as follows:

- ***Two years from the effective date of the revisions in the amendment to the 2009 MUTCD***, all agencies will have to implement and continue to use an assessment or management method that is designed to maintain regulatory and warning sign reroreflectivity at or above the established minimum levels

1.2 References

References and resources for this work include, but are not limited to:
Ohio Manual of Uniform Traffic Control Devices (OMUTCD) – current version –
http://www.dot.state.oh.us/Divisions/HighwayOps/Traffic/publications2/OhioMUTCD/Pages/

Section 2A.08 – Retroreflectivity and Illumination
Section 2A.09 – Maintaining Minimum Retroreflectivity
Section 2A.22 – Maintenance

Additional parts/sections of the OMUTCD should be referred to as needed with regard to traffic sign management and maintenance functions.
Ohio Revised Code – Sections 4511.09 and 4511.11
Federal Highway Administration (FHWA) – Sign Retroreflectivity Resources
Toolkit – http://safety.fhwa.dot.gov/roadway_dept/night_visib/retrotoolkit/
Guide – http://safety.fhwa.dot.gov/roadway_dept/night_visib/policy_guide/fhwasa07020/
Additional Information – http://safety.fhwa.dot.gov/roadway_dept/night_visib/sign_visib/

2. Policy Statement

Deerfield Township will use the plan, method(s) and procedure(s) described herein to evaluate and maintain retroreflectivity of traffic signs under its jurisdiction, in accordance with the most current version of the Ohio Manual of Uniform Traffic Control Devices.

3. Implementation Plan

The anticipated steps in this plan for calendar year 2012 are as follows.

- Complete a traffic sign inventory for the Township (see section 4 of this document), and identify any sign problems/deficiencies that require corrective action.
- Use the selected method and procedure (see section 5) to evaluate the retroreflectivity of the Township's traffic signs.
- Identify signs that do not meet the OMUTCD retroreflectivity requirements.
- Establish and program for replacement of signs that do not meet the OMUTCD retroreflectivity requirements.

In light of the first compliance date (see section 1.1), the Township hereby resolves to proceed with the implementation plan by January 22, 2012, or earlier if possible.

Based on experience gained as this program is implemented, the Township may review and modify its approach to this work as needed in order to:

- comply with the traffic sign retroreflectivity requirements per the OMUTCD; and
- provide for the safety of sign inspection/maintenance personnel, motorists, and other road users.

Any significant changes made to the plan, method(s) or procedure(s) will be documented.

4. Traffic Sign Inventory

Daytime inspections will be conducted to identify and document all traffic signs under the Township's jurisdiction. At a minimum, the documentation from these inspections will include the sign type, location, and condition (see Appendix A). The inspections will also identify:

- Any damaged, deteriorated, or obscured signs, or other sign problems, that require immediate corrective action in the interest of traffic safety.
- Any signs or sign installations that do not meet the standards and requirements set forth in the OMUTCD.

The Township will take appropriate and reasonable steps to correct any sign problems/deficiencies identified.

The data collected during the inspections will be used to create an inventory of the Township's traffic signs. At the Township's discretion, the sign inspection sheets will be organized in a filing system and, data from the inspection sheets may be transferred to a separate spreadsheet or computer database which is collected from the GIS system. The Township will evaluate the available options and methods for long-term maintenance and updating of its sign inventory.

The Township has been divided into Ten (10) Zones for conducting traffic sign inspections and data collection(see Appendix B). The inventory process and inspection documentation will correspond to the roads and traffic signs the Township is responsible for within each Zone. The sign inventory should be completed for all Zones by February 1, 2012.

5. Method for Maintaining Traffic Sign Retroreflectivity

The OMUTCD describes several assessment and management methods that may be used to maintain traffic sign retroreflectivity. For calendar year 2012, the Township will begin to use the **Blanket Replacement Program Method combined with an Expected Sign Life Replacement Program** to evaluate and maintain the retroreflectivity of traffic signs on its roads.

The Blanket Replacement Program:

The OMUTCD describes Blanket Replacement, "All signs in an area / corridor, or of a given type, should be replaced at specified intervals. This eliminates the need to assess retroreflecitivity or track the life of individual signs. The replacement interval is based on the expected sign life, compared to the minimum levels, for the shortest life material used on the affected signs."

Under this portion of the assessment and management program, the Township will inspect and replace all signs on roadways to be resurfaced within that program year. Any signs not meeting the current retroreflectivity levels will be replaced at that time. The data for each sign will be logged within the maintenance history file, collected in the GIS system, and will then have an established replacement date based on life expectancy.

Expected Sign Life Program:

The OMUTCD decribs Expected Sign Life as**, "**When signs are installed, the installation date is labeled or recorded so that the age of a sign is known. The age of the sign is compared to the expected sign life. The expected sign life is based on the experience of sign retroreflectivity degradation in a geographic area compared to the minimum levels. Signs older than the expected life should be replaced."

When signs are scheduled to be replaced under our blanket replacement when roadways are resurfaced; or are replaced for any other reason; they will be replaced with the material meeting the new MUTCD retroreflectivity guidelines. The Township will then monitor (through our GIS data base and annual inspections) the expected life of those signs based on manufacturer warranty data and will replace the signs accordingly; once they drop below the approved reflectivity threshold based on age or are damaged beyond repair. Based on the expected sign life and warranty information listed in Appendix C, our signs should all have a 10 year period for which they remain within the minimum retroreflectivity allowable limit.

5.1 Procedure

The Federal Highway Administration has published several resources that include recommendations and instructions for proper use of the Blanket Replacement Program and the Expected Sign Life Program. The Township will review these resources and adopt appropriate inspection practices for properly using those procedures to comply with the OMUTCD retroreflectivity standards. The procedure steps and requirements will be listed and attached to this document.

5.2 Inspector(s)

The Township hereby designates the following person(s) to serve as retroreflectivity inspector(s):

Eric Reiners Jim Houston Billy Highfill

The Township has determined that the designated person(s) are able to competently serve as inspector(s) for evaluating traffic sign retroreflectivity. The Township will review applicable FHWA guidelines and resources with regard to inspector training, and will determine the type(s) or extent of training their inspector(s) will need in order to perform this function in accordance with the OMUTCD requirements.

5.3 Schedule and Documentation

The Township will begin its use of the Blanket Replacement Program and Expected Sign Life Replacement Program Procedures to evaluate traffic sign retroreflectivity no later than January 22, 2012.

The retroreflectivity inspection records will be kept in filing system that will be accessible to the Township Trustees. Documentation from each inspection process will be kept for a period of at least seven years.

6. Additional Responsibilities for Traffic Sign Management and Maintenance

Retroreflectivity is just one of several factors associated with proper functioning of traffic signs. The Township continues to be responsible for the overall management and regular maintenance of signs under its jurisdiction, in the interest of traffic safety. The Township will inspect each zone annually to ensure signs are properly maintained. Any sign found to be in need of replacement, will be replaced with the new retroreflectivity standard.

Inspection forms will be completed for the signs in each zone, and any maintenance performed will be recorded in the master sign log.

The following text is included in OMUTCD Section 2A.22 – Maintenance:

> "Maintenance activities should consider proper position, cleanliness, legibility, and daytime and nighttime visibility (see Section 2A.09). Damaged or deteriorated signs should be replaced.
>
> To assure adequate maintenance, a schedule for inspecting (both day and night), cleaning, and replacing signs should be established. Employees of highway, law enforcement, and other public agencies whose duties require that they travel on the roadways should be encouraged to report any damaged, deteriorated, or obscured signs at the first opportunity.

Steps should be taken to see that weeds, trees, shrubbery, and construction, maintenance, and utility materials and equipment do not obscure the face of any sign."

Responsibility and authority for directing the Township's various sign management and maintenance functions, including the retroreflectivity maintenance program, is hereby assigned to:

The Director of Public Works for Deerfield Township.

7. Documentation and Recordkeeping

The Township will establish a recordkeeping system to organize the documentation relating to its traffic sign management and maintenance functions, including:

- Creating and maintaining the sign inventory consisting of GIS sign locations and attributes
- Conducting annual condition inspections of signs through each assigned zone
- Conducting retroreflectivity inspections of signs based on the methods listed above.
- Maintenance-related activities / corrective actions / emergency measures, including those done in response to notification or discovery of knocked down, missing, damaged, deteriorated, or obscured signs .

Documentation from each inspection cycle and maintenance-related activity will be kept on file for a period of at least seven years.

8. Annual Program Review and Renewal

Traffic sign retroreflectivity degrades over time. Therefore, maintaining retroreflectivity is an ongoing responsibility. The Township will review and renew this program document at least once per year. The usual process will be to conduct the review by October 15th for the next calendar year. Any needed changes will be made to the document, and the updated version for the next year will be adopted under the authority of the Township Trustees no later than December 15th.

The Township is responsible for identifying any applicable future updates or revisions to the Ohio MUTCD standards or Federal regulations relating to traffic control devices, and updating this program document (including appendices/attachments) as needed to assure compliance.

Over time, the Township may consider using other sign retroreflectivity assessment or management methods. Future renewals or revisions of this program document will describe the method(s), procedure(s), and the timeframe or frequency with which they will be used. The Township may also consider expanding this program document to more fully describe its other traffic sign maintenance and management functions.

The Township may consult with the Warren County Engineer's Office for general guidance and further information regarding traffic sign maintenance and management issues.

9. Authorizing Signatures

The provisions set forth in this program document are hereby adopted this _____ day of _____ , 2011, for implementation by _____ Township, under the authority of the Township Trustees:

_____

Name Signature Date

_____

Name Signature Date

_____

Name Signature Date

Appendix A

Monthly Traffic Sign Inspections & Maintenance Forms

The monthly traffic sign inspections will be done by each designated zone. A spreadsheet of all signs within that zone will be generated monthly and will be used to inspect sign conditions. Any sign requiring maintenance or replacement will have the attached form completed and recorded.

Sign Work Form

Sign #_____ Name:_____

Sign Work Performed

_____Clean Sign Face
_____Correct Visibility Problem
_____Install Sign
_____Move Sign – Adjust Log Point to _____
_____Realign Support
_____Remove Sign
_____Replace Sign
_____Replace Sign w/ Correct Size
_____Replace Support
_____Reset Support
_____Tighten Sign Fasteners
_____Tighten Support Fasteners
_____Too High – Reposition Sign
_____Too Low – Reposition Sign
_____Visibility Obstructed – Reposition Sign
_____ _____
_____ _____

Materials Used:_____
_____
_____
_____

Crew:_____

Date/Time Completed____/____/____ ____:____

Total Job Hours:_____

	Color	Reflectivity
Legend:	_____	_____
Backgrnd:	_____	_____

New Sign Install

1) Sign #:_____
Sign Code:_____
Sign Width:_____ Height:_____
Number of Signs on Posts:_____

Offset:_____ Height:_____ OK

2) Sign #:_____
Sign Code:_____
Sign Width:_____ Height:_____

Face Material
____Eng. Grade
____Dia. Grade
____Hi Int.

Blank Material
____Aluminum
____Fiberglass
____Wood
____Steel

Side of Road
____Right
____Left
____Overhead
____Island/Gore
____Ahead
____Behind

Dir. Of Face
____North
____South
____East
____West
____N & S
____E & W

Support Type
____U-Channel
____B to B U-Channel
____Round Pipe
____Solid Wood Post
____Overhead Span Wire
____Telephone
____Existing Structure
____ _____

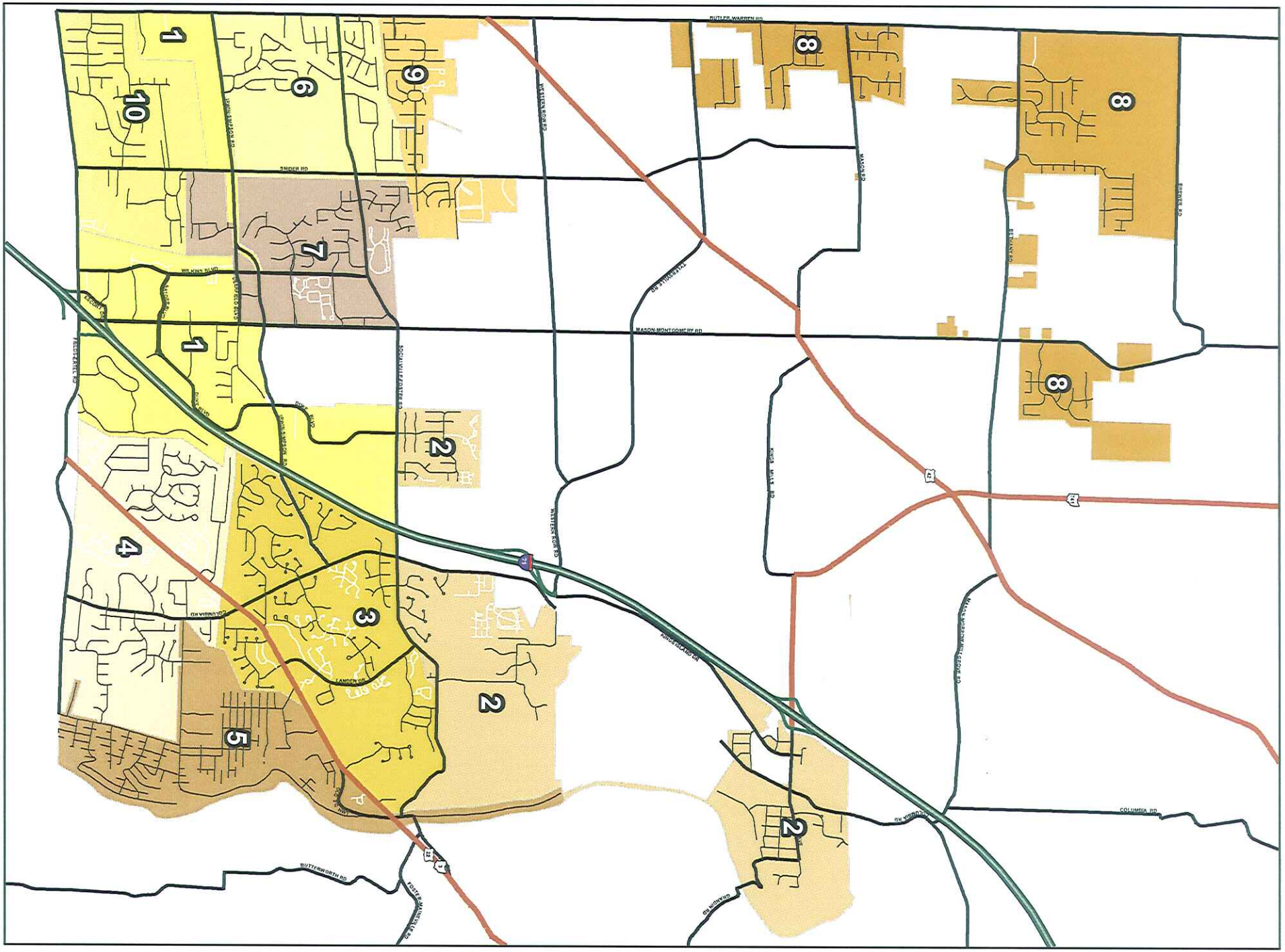
Other Info
____Breakaway
____Illuminated
____Beacon

Appendix B

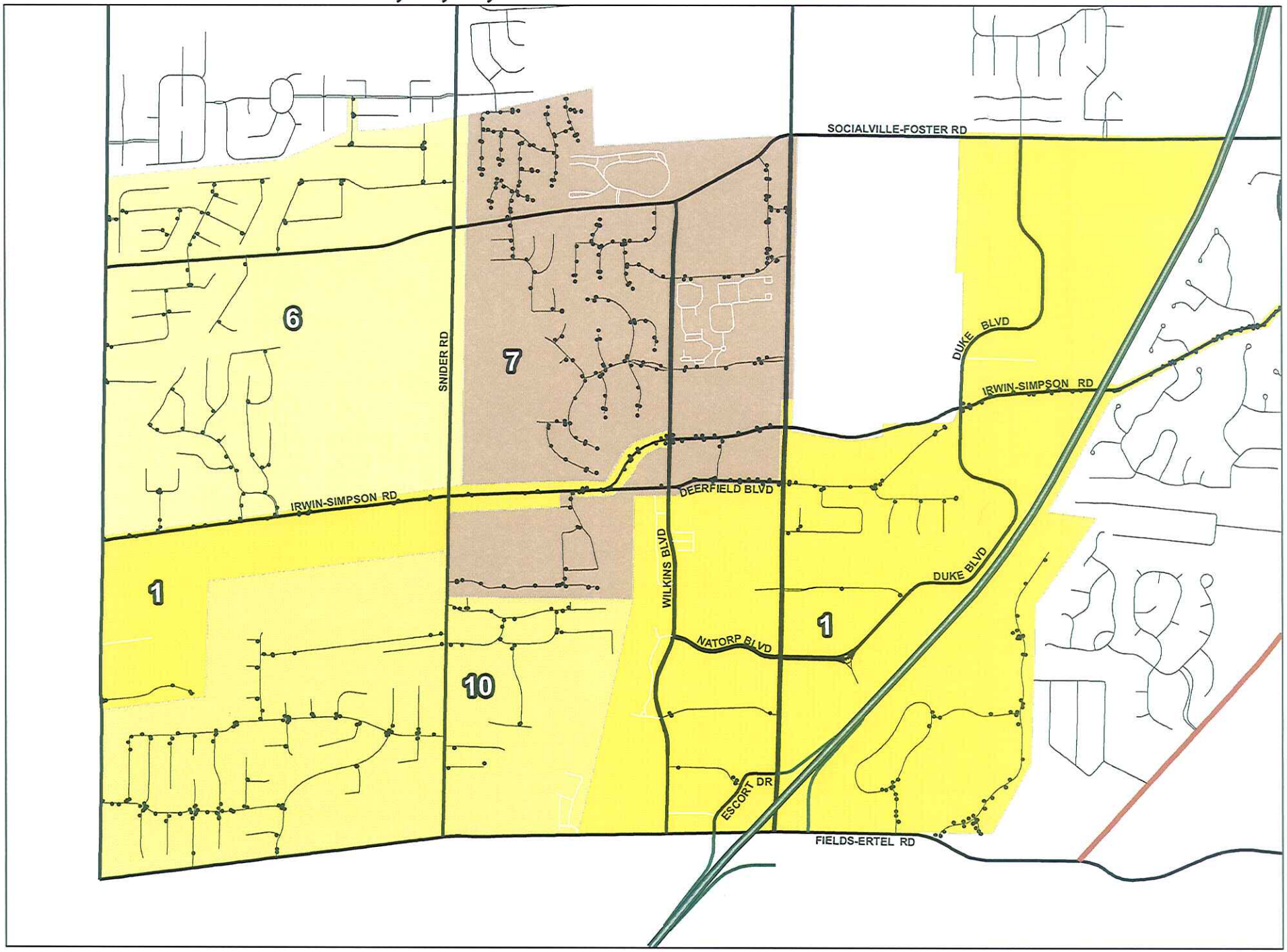
Map of Township Zones for Traffic Sign Inspection

The Township has been divided into Ten Zones for conducting monthly traffic sign inspections. The inventory process and inspection documentation will correspond to the roads and traffic signs the Township is responsible for within each Zone. The attached Township map shows the Zones and their boundaries. At a minimum, each zone will be inspected once annually.

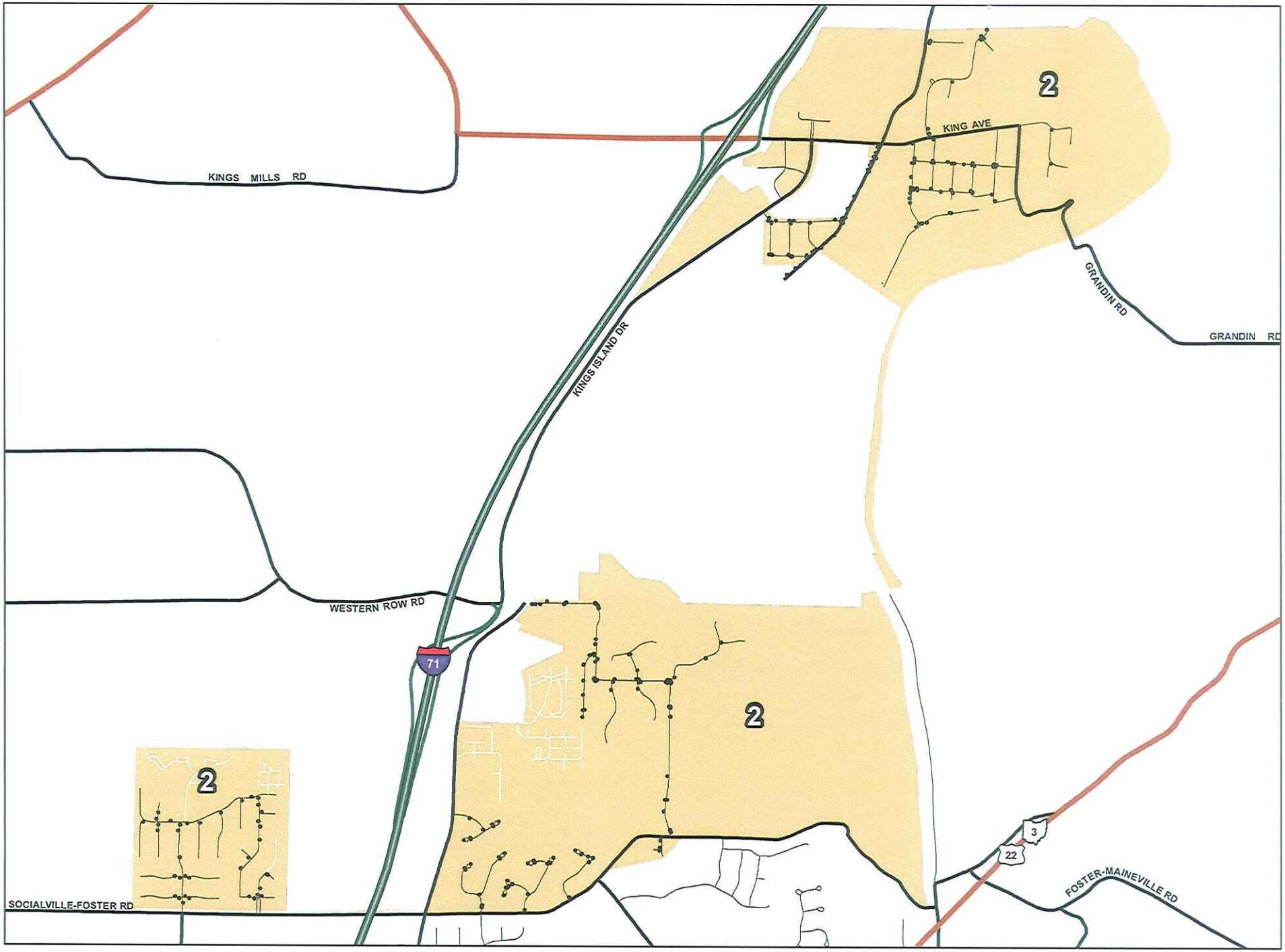
Maintenance Zones



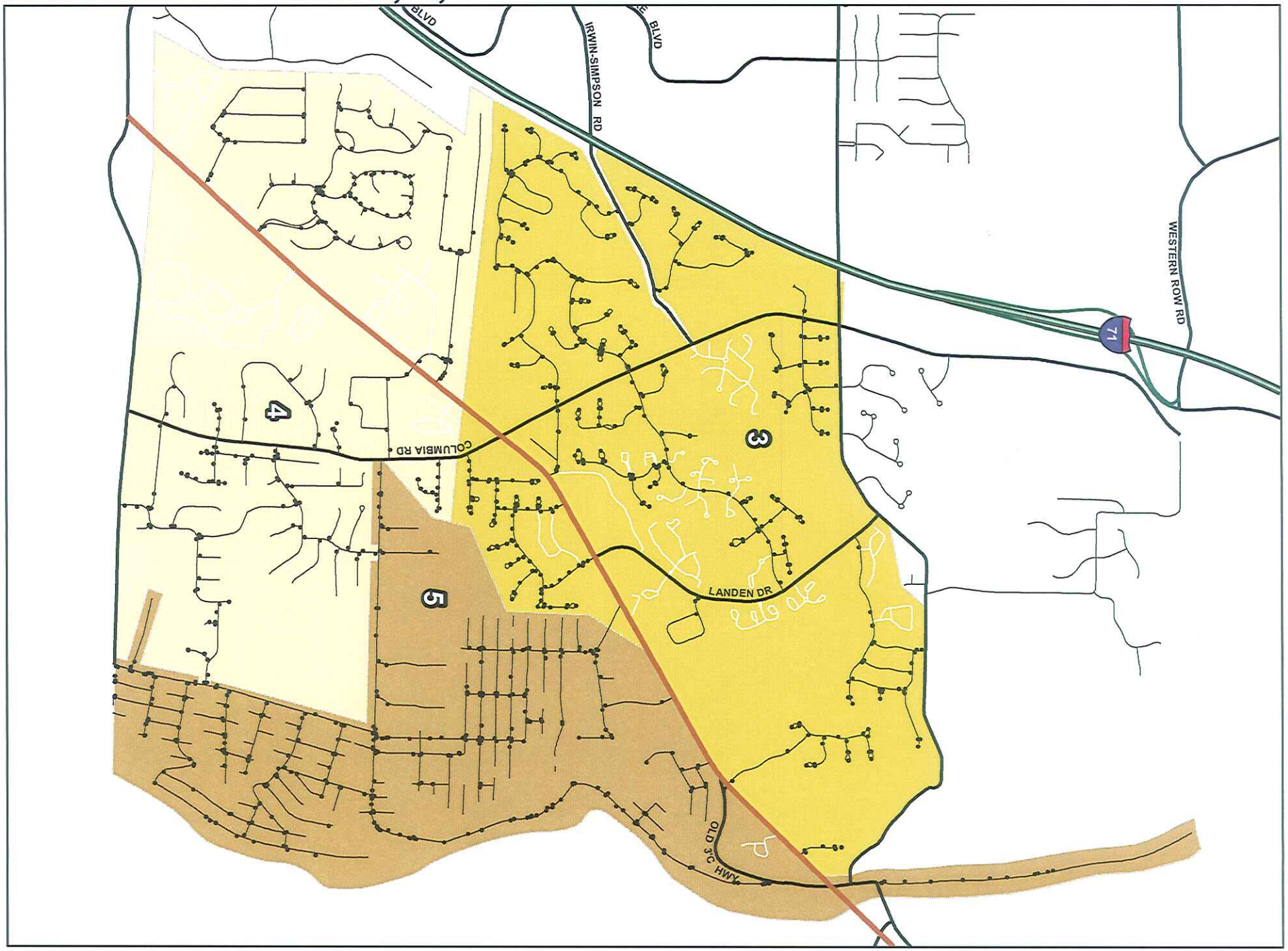
Maintenance Zone 1, 6, 7, 10



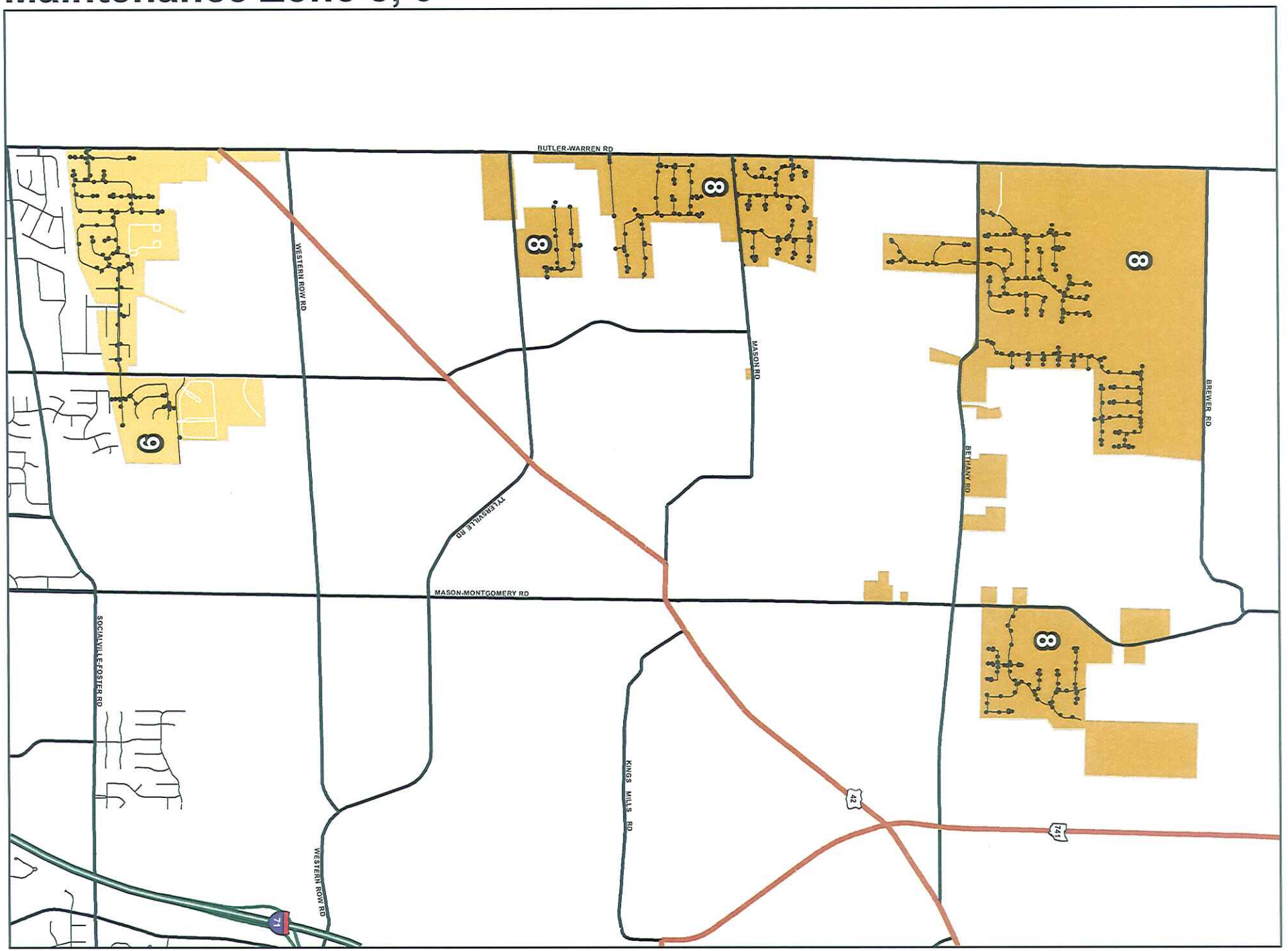
Maintenance Zone 2



Maintenance Zone 3, 4, 5



Maintenance Zone 8, 9



Appendix C

Minimum Retroreflectivity Levels and Expected Sign Life Information

All signs being replaced within the Township will need to meet the minimum levels listed below; and as referenced in the manufacturer warranty information for the expected sign life.

Table 2A-3. Minimum Maintained Retroreflectivity Levels[1]

Sign Color	Sheeting Type (ASTM D4956-04)				Additional Criteria
	Beaded Sheeting			Prismatic Sheeting	
	I	II	III	III, IV, VI, VII, VIII, IX, X	
White on Green	W*; G ≥ 7	W*; G ≥ 15	W*; G ≥ 25	W ≥ 250; G ≥ 25	Overhead
	W*; G ≥ 7	W ≥ 120; G ≥ 15			Post-mounted
Black on Yellow or Black on Orange	Y*; O*	Y ≥ 50; O ≥ 50			[2]
	Y*; O*	Y ≥ 75; O ≥ 75			[3]
White on Red	W ≥ 35; R ≥ 7				[4]
Black on White	W ≥ 50				–

[1] The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m² measured at an observation angle of 0.2° and an entrance angle of -4.0°.
[2] For text and fine symbol signs measuring at least 48 inches and for all sizes of bold symbol signs
[3] For text and fine symbol signs measuring less than 48 inches
[4] Minimum sign contrast ratio ≥ 3:1 (white retroreflectivity ÷ red retroreflectivity)
* This sheeting type shall not be used for this color for this application.

Bold Symbol Signs

- W1-1,2 – Turn and Curve
- W1-3,4 – Reverse Turn and Curve
- W1-5 – Winding Road
- W1-6,7 – Large Arrow
- W1-8 – Chevron
- W1-10 – Intersection in Curve
- W1-11 – Hairpin Curve
- W1-15 – 270 Degree Loop
- W2-1 – Cross Road
- W2-2,3 – Side Road
- W2-4,5 – T and Y Intersection
- W2-6 – Circular Intersection
- W2-7,8 – Double Side Roads
- W3-1 – Stop Ahead
- W3-2 – Yield Ahead
- W3-3 – Signal Ahead
- W4-1 – Merge
- W4-2 – Lane Ends
- W4-3 – Added Lane
- W4-5 – Entering Roadway Merge
- W4-6 – Entering Roadway Added Lane
- W6-1,2 – Divided Highway Begins and Ends
- W6-3 – Two-Way Traffic
- W10-1,2,3,4,11,12 – Grade Crossing Advance Warning
- W11-2 – Pedestrian Crossing
- W11-3,4,16-22 – Large Animals
- W11-5 – Farm Equipment
- W11-6 – Snowmobile Crossing
- W11-7 – Equestrian Crossing
- W11-8 – Fire Station
- W11-10 – Truck Crossing
- W12-1 – Double Arrow
- W16-5P,6P,7P – Pointing Arrow Plaques
- W20-7 – Flagger
- W21-1 – Worker

Fine Symbol Signs (symbol signs not listed as bold symbol signs)

Special Cases

- W3-1 – Stop Ahead: Red retroreflectivity ≥ 7
- W3-2 – Yield Ahead: Red retroreflectivity ≥ 7; White retroreflectivity ≥ 35
- W3-3 – Signal Ahead: Red retroreflectivity ≥ 7; Green retroreflectivity ≥ 7
- W3-5 – Speed Reduction: White retroreflectivity ≥ 50
- For non-diamond shaped signs, such as W14-3 (No Passing Zone), W4-4P (Cross Traffic Does Not Stop), or W13-1P,2,3,6,7 (Speed Advisory Plaques), use the largest sign dimension to determine the proper minimum retroreflectivity level.

Source: 2009 MUTCD Table 2A-3, pg 31

Qualified Product List

Ohio Department of Transportation

Spec Reference: 730.19

Click on Brand Name for any additional information

Sample Id	PS CD	Mtl Cd	Mtl Name	Brand Name	P/S Name	Street	City	St/Zip	Phone
QPLITEMS000103	00619-01	60819	REFLECTIVE SHEETING TYPE G	314-L, R	3 M TRAFFIC CTRL MAT	3M CENTER, BUILDING 235-3B-55	ST. PAUL	MN 55144	651-736-0166
QPLITEMS000102	00619-01	60819	REFLECTIVE SHEETING TYPE G	316-L, R	3 M TRAFFIC CTRL MAT	3M CENTER, BUILDING 235-3B-55	ST. PAUL	MN 55144	651-736-0166
QPLITEMS000096	00619-01	60819	REFLECTIVE SHEETING TYPE G	334-L, R	3 M TRAFFIC CTRL MAT	3M CENTER, BUILDING 235-3B-55	ST. PAUL	MN 55144	651-736-0166
QPLITEMS000095	00619-01	60819	REFLECTIVE SHEETING TYPE G	336-L, R	3 M TRAFFIC CTRL MAT	3M CENTER, BUILDING 235-3B-55	ST. PAUL	MN 55144	651-736-0166
QPLITEMS000105	00619-01	60819	REFLECTIVE SHEETING TYPE G	3820	3 M TRAFFIC CTRL MAT	3M CENTER, BUILDING 235-3B-55	ST. PAUL	MN 55144	651-736-0166
QPLITEMS000104	00619-01	60819	REFLECTIVE SHEETING TYPE G	3821	3 M TRAFFIC CTRL MAT	3M CENTER, BUILDING 235-3B-55	ST. PAUL	MN 55144	651-736-0166
QPLITEMS000098	00619-01	60819	REFLECTIVE SHEETING TYPE G	3937	3 M TRAFFIC CTRL MAT	3M CENTER, BUILDING 235-3B-55	ST. PAUL	MN 55144	651-736-0166
QPLITEMS000106	00619-01	60819	REFLECTIVE SHEETING TYPE G	3879	3 M TRAFFIC CTRL MAT	3M CENTER, BUILDING 235-3B-55	ST. PAUL	MN 55144	651-736-0166
QPLITEMS000100	00619-01	60819	REFLECTIVE SHEETING TYPE G	3930	3 M TRAFFIC CTRL MAT	3M CENTER, BUILDING 235-3B-55	ST. PAUL	MN 55144	651-736-0166
QPLITEMS000099	00619-01	60819	REFLECTIVE SHEETING TYPE G	3931	3 M TRAFFIC CTRL MAT	3M CENTER, BUILDING 235-3B-55	ST. PAUL	MN 55144	651-736-0166
QPLITEMS000097	00619-01	60819	REFLECTIVE SHEETING TYPE G	3932	3 M TRAFFIC CTRL MAT	3M CENTER, BUILDING 235-3B-55	ST. PAUL	MN 55144	651-736-0166
QPLITEMS000101	00619-01	60819	REFLECTIVE SHEETING TYPE G	3934	3 M TRAFFIC CTRL MAT	3M CENTER, BUILDING 235-3B-55	ST. PAUL	MN 55144	651-736-0166
QPLITEMS000107	00619-01	60819	REFLECTIVE SHEETING TYPE G	3877	3 M TRAFFIC CTRL MAT	3M CENTER, BUILDING 235-3B-55	ST. PAUL	MN 55144	651-736-0166

Qualified Product List

Ohio Department of Transportation

Spec Reference: 730.19

Sample Id	PS CD	Mtl Cd	Mtl Name	Brand Name	P/S Name	Street	City	St/Zip	Phone
QPLITEMS105K112518	00619-01	60819	REFLECTIVE SHEETING TYPE G	3935	3 M TRAFFIC CTRL MAT	3M CENTER, BUILDING 235-3B-55	ST. PAUL	MN 55144	651-736-0166
QPLITEMS000026	00512-01	60819	REFLECTIVE SHEETING TYPE G	W-6244	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000025	00512-01	60819	REFLECTIVE SHEETING TYPE G	W-6245	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000027	00512-01	60819	REFLECTIVE SHEETING TYPE G	W-6243	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000028	00512-01	60819	REFLECTIVE SHEETING TYPE G	W-6242	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000029	00512-01	60819	REFLECTIVE SHEETING TYPE G	W-5504A	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000031	00512-01	60819	REFLECTIVE SHEETING TYPE G	T-6509	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000033	00512-01	60819	REFLECTIVE SHEETING TYPE G	T-6508	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000032	00512-01	60819	REFLECTIVE SHEETING TYPE G	T-6507	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000030	00512-01	60819	REFLECTIVE SHEETING TYPE G	T-6505	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000034	00512-01	60819	REFLECTIVE SHEETING TYPE G	T-6501	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000035	00512-01	60819	REFLECTIVE SHEETING TYPE G	T-6500	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000036	00512-01	60819	REFLECTIVE SHEETING TYPE G	T-5509A	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000039	00512-01	60819	REFLECTIVE SHEETING TYPE G	T-5508A	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000037	00512-01	60819	REFLECTIVE SHEETING TYPE G	T-5507A	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000038	00512-01	60819	REFLECTIVE SHEETING TYPE G	T-5505A	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000040	00512-01	60819	REFLECTIVE SHEETING TYPE G	T-5501A	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717
QPLITEMS000041	00512-01	60819	REFLECTIVE SHEETING TYPE G	T-5500A	AVERY DENNISON	7542 N. NATCHEZ AVE.	NILES	IL 60714	847-647-7717

Qualified Product List

Ohio Department of Transportation

Spec Reference: 730.19

Sample Id	PS CD	Mtl Cd	Mtl Name	Brand Name	P/S Name	Street	City	St/Zip	Phone
QPLITEMS001789	96007-01	60819	REFLECTIVE SHEETING TYPE G	N805	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001775	96007-01	60819	REFLECTIVE SHEETING TYPE G	CN504	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001787	96007-01	60819	REFLECTIVE SHEETING TYPE G	N808	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001786	96007-01	60819	REFLECTIVE SHEETING TYPE G	N809	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001791	96007-01	60819	REFLECTIVE SHEETING TYPE G	N812	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001790	96007-01	60819	REFLECTIVE SHEETING TYPE G	N804	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001777	96007-01	60819	REFLECTIVE SHEETING TYPE G	N517	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001779	96007-01	60819	REFLECTIVE SHEETING TYPE G	N515	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001785	96007-01	60819	REFLECTIVE SHEETING TYPE G	N512	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001780	96007-01	60819	REFLECTIVE SHEETING TYPE G	N509	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001781	96007-01	60819	REFLECTIVE SHEETING TYPE G	N508	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001778	96007-01	60819	REFLECTIVE SHEETING TYPE G	N507	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001782	96007-01	60819	REFLECTIVE SHEETING TYPE G	N506	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001783	96007-01	60819	REFLECTIVE SHEETING TYPE G	N505	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264

Qualified Product List

Ohio Department of Transportation

Spec Reference: 730.19

Sample Id	PS CD	Mtl Cd	Mtl Name	Brand Name	P/S Name	Street	City	St/Zip	Phone
QPLITEMS001784	96007-01	60819	REFLECTIVE SHEETING TYPE G	N504	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001776	96007-01	60819	REFLECTIVE SHEETING TYPE G	CN512	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001770	96007-01	60819	REFLECTIVE SHEETING TYPE G	CN509	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001771	96007-01	60819	REFLECTIVE SHEETING TYPE G	CN508	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001772	96007-01	60819	REFLECTIVE SHEETING TYPE G	CN507	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001773	96007-01	60819	REFLECTIVE SHEETING TYPE G	CN506	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001774	96007-01	60819	REFLECTIVE SHEETING TYPE G	CN505	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264
QPLITEMS001788	96007-01	60819	REFLECTIVE SHEETING TYPE G	N806	NIPPON CARBIDE/CA	12981 EAST FLORENCE AVENUE	SANTA FE SPRINGS	CA 90670	800-821-4264

Avery Dennison® T-6000 & W-6000 HIP Series

High Intensity Microprismatic Retroreflective Film

Issued: April 2011 Revision 1

Avery Dennison® T-6000 & W-6000 Series High Intensity Microprismatic (HIP) Retroreflective Film for permanent and temporary traffic signage, is a high-quality, durable, microprismatic retroreflective material with a pressure sensitive adhesive. Its unique microprismatic construction provides a high level of retroreflectivity for demanding traffic control situations.

T-6000 & W-6000 Series sheeting is an Omni-Directional microprismatic film that incorporates tiles of microprisms arranged in multiple orientations. This feature – "Smart at Every Angle" benefits agencies by providing confidence that all signs will perform with uniform visual reflectivity at all sign face orientations.

Performance:
ASTM D4956 Type III & IV,
CUAP Table 7
See Page 2 for complete list.

Orientation: Omni-Directional

Durability: 10 year
Vertical Exposure only

Face: High-Gloss Acrylic Retroreflective Film with Microprisms

Adhesive: Permanent Pressure Sensitive

Liner: Polypropylene Film

Features:

- Omni-Directional
- High Intensity Microprismatic Retroreflective Performance
- Field proven long term durability on safety devices worldwide
- Uniform daytime and nighttime visual appearance

Conversion:

☒ Screen Printing
☒ Thermal Transfer Printing
☒ Solvent Based Inkjet Printing
☒ Mild/Eco Solvent Inkjet Printing
☒ UV Inkjet Printing
☒ Thermal Die-Cut
☒ Flat Bed Sign-Cut
☒ Drum Roller Sign-Cut
☒ Steel Rule Sign-Cut

Applications:

☒ Rigid Permanent and Temporary Outdoor Signage
☒ Rigid Work Zone Devices
☒ Safety Devices that Require Robust Retroreflective Performance

Product Availability*:

Traffic Products		
T-6500	White	
T-6501	Yellow	
T-6505	Blue	
T-6507	Green	
T-6508	Red	
T-6509	Brown	
Work Zone Products*		
W-6100	White	
W-6200	White	
W-6204	Orange	
W-6504	Orange	
W-6511	Fluorescent Yellow	
W-6513	Fluorescent Yellow-Green	
W-6142	Orange Pre-Striped Barricade	4" Left
W-6143		4" Right
W-6144		6" Left
W-6145		6" Right
W-6242		4" Left
W-6243		4" Right
W-6244		6" Left
W-6245		6" Right

*See Page 5 for Nomenclature.
**3 Year Durability

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Revision 1

Retroreflectivity:

Table A:

Min. coefficients of retroreflection (R_A)[1] per ASTM D4956[2] Type III & IV

Observation Angle	Color	Entrance Angle	
		-4°	+30°
0.1°[3]	White	500	240
	Yellow	380	175
	Orange	200	94
	Blue	42	20
	Green	70	32
	Red	90	42
	Brown	25	12
	Fluorescent Yellow	300	140
	Fluorescent Yellow-Green	400	185
0.2°	White	360	170
	Yellow	270	135
	Orange	145	68
	Blue	30	14
	Green	50	25
	Red	65	30
	Brown	18	8.5
	Fluorescent Yellow	220	100
	Fluorescent Yellow-Green	290	135
0.5°	White	150	72
	Yellow	110	54
	Orange	60	28
	Blue	13	6.0
	Green	21	10
	Red	27	13
	Brown	7.5	3.5
	Fluorescent Yellow	90	40
	Fluorescent Yellow-Green	120	55

Table B:

Min. coefficients of retroreflection (R_A)[1] CUAP Table 7 (EN-12899 RA2)

α Observation Angle	Color	β1 (β2=0°) Entrance Angle		
		+5°	+30°	+40°
12' (0.2°)	White	250	150	110
	Yellow	170	100	70
	Orange	100	60	29
	Blue	20	11	8
	Green	45	25	12
	Red	45	25	15
	Brown	12	8.5	5.0
20' (0.33°)	White	180	100	95
	Yellow	120	70	60
	Orange	65	40	20
	Blue	14	8.0	7.0
	Green	21	12	11
	Red	25	14	13
	Brown	8.0	5.0	3.0
2°	White	5.0	2.5	1.5
	Yellow	3.0	1.5	1
	Orange	1.5	1	--
	Blue	0.2	--	--
	Green	0.5	0.3	0.2
	Red	1	0.4	0.3
	Brown	0.2	--	--

HIP Series sheeting **exceeds** all values listed in **Table A** and **Table B.**

HIP Series sheeting also **exceeds** the current applicable requirements for the following specifications:

ASTM D4956	International
AASHTO M268	USA
CUAP	EU
GB/T 18833	China
N-CMT-5-03-001	Mexico
UNE 135340	Spain
NF XP98520	France
BSI 8408	UK
UNI 11122	Italy
JIS Z9117	Japan
SANS 1519-1	South Africa
AS/NZS 1906.1	Australia New Zealand
ABNT NBR 14644	Brazil
IRAM 3952	Argentina

Avery Dennison suggests you obtain the current requirements from your local agency and ensure product conformance with such requirements. Your Avery Dennison Representative can assist you in this regard.

R_A = candelas per foot-candle per square foot (cd/fc/ft^2) OR Candelas per lux per square meter (cd/lx/m^2)

[2] Measured according to ASTM E810

[3] Note that 0.1° Observation angle is a "supplemental Requirement" in ASTM D4956. It represents long highway viewing distances of about 900 ft (275 Meters) and greater.

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Avery Dennison® T-6000 & W-6000 HIP Series

High Intensity Microprismatic Retroreflective Film

Issued: April 2011

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Colors and Specification Limits:

Figure A: Daytime Color

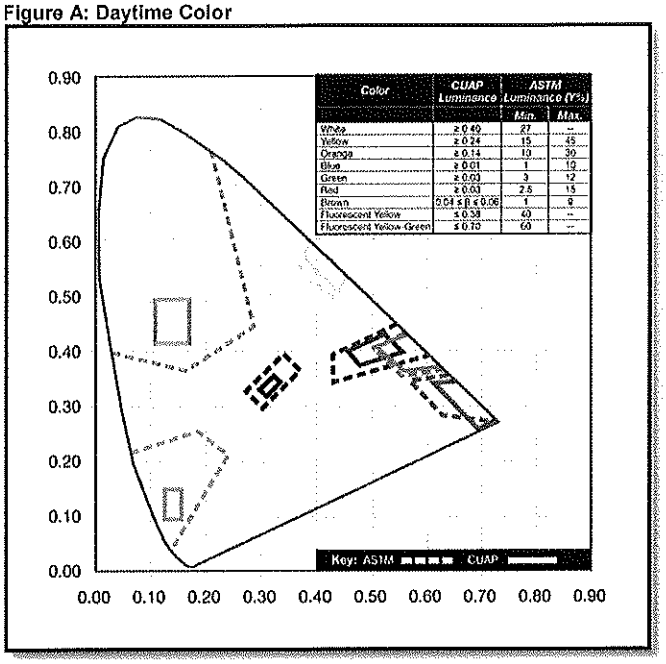
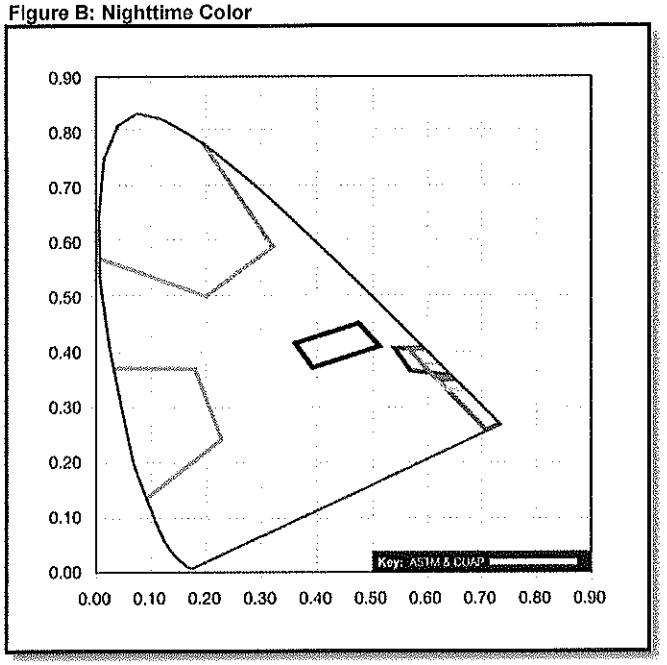


Figure B: Nighttime Color



HIP Series sheeting **meets** the current applicable daytime and nighttime color requirements for ASTM D4956 and CUAP as well as standards listed on Page 2.

Chromaticity Coordinate Limits

Figures A & B show the four pairs of chromaticity coordinates from ASTM D4956 and CUAP on the color grid.

Daytime Color

The four pairs of chromaticity coordinates in **Figure A** determine the acceptable color in terms of the CIE 1931 Standard Colorimetric System measured with Standard Illuminant D65 and CIE Publication no. 15 using CIE Standard Illuminant D65 and CIE 45/0 geometry. Luminance factor shall comply with table in **Figure A.**
Note: The saturation limit of green and blue may extend to the border of the CIE chromaticity locus for spectral colors

Nighttime Color

The four pairs of chromaticity coordinates in **Figure B** determine the acceptable color measured 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 1930 (2 degree) standard observer per ASTM D4956.

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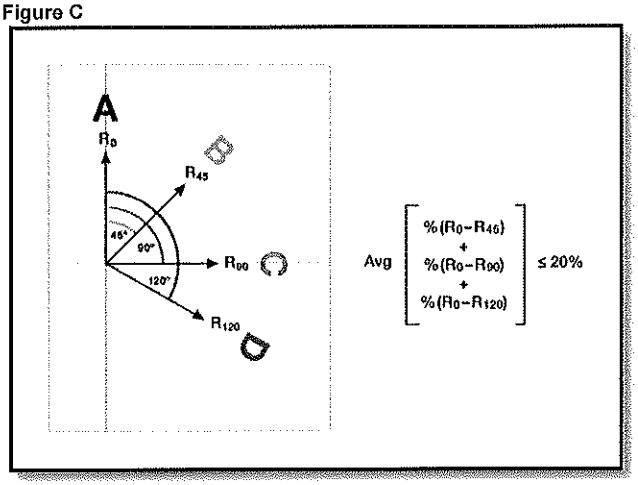
Sheeting Orientation:

The American Association of State Highway Transportation Officials (AASHTO) has recognized that some retroreflective films are rotationally (orientation) sensitive. Because this impacts sign luminance, AASHTO has defined a specification to measure orientation performance. **Figure C** shows how the orientation sensitivity is measured. In order for a film to be considered rotationally insensitive the average percent difference (shown in **Figure C**) must be less than or equal to 20%.

Figure C



When measured for orientation sensitivity as described in AASHTO M 268-10, all Avery Dennison sheeting, both beaded and prismatic, **pass** the specification as **rotationally insensitive**. Therefore no special identification marks or other features (such as a datum mark, or distinctive seal pattern) are required to denote optimum orientation for sheeting. Because the user can expect visual uniformity regardless of orientation, no costly and cumbersome fabrication techniques are required to orient sheets, cut sign legend or border tape during sign fabrication.

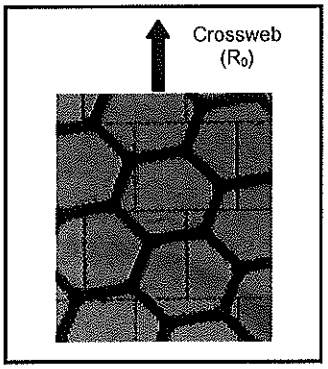
Specifying agencies and sign fabricators are cautioned that some retroreflective sheetings, even of the same ASTM "Type" may not provide consistent luminance for desired night visibility if the sheeting is not applied in the optimal, or in uniform orientation. Agencies and fabricators should be aware of this concern and discuss the potential effects of rotation on luminance of specific sheetings with their material supplier before beginning installation and/or fabrication.

HIP Series sheeting is Omni-Directional and **passes** the AASTHO specification as being **rotationally insensitive.**

Retroreflectivity R_A values taken per ASTM E810
0.5° Observation angle and
-4° or 5° Entrance angle

As a datum for laboratory measurements R_0 is identified in the crossweb direction. See **Figure D**

Figure D



Watermark: HIP Series contains the watermark seen in **Figure E.**

Figure E

HIP Lot #

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Avery Dennison® T-6000 & W-6000 HIP Series

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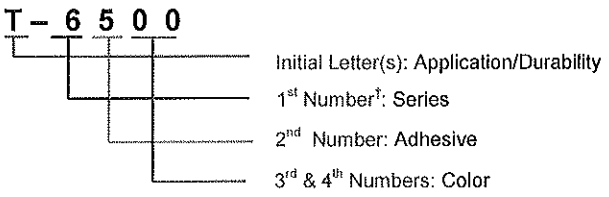
Nomenclature:



Initial Letter	Application	Durability*
T	Traffic/Permanent Sheeting	10 year
W	Work Zone Sheeting	3 year
WR	Work Zone Reboundable	3 year

* See your local representative for complete details.

Series	6000

2nd Number	Substrate
1	Pressure Sensitive for Plastic Substrates
2	Pressure Sensitive for Wood Substrates
5	Pressure Sensitive for Aluminum Substrates

3rd & 4th Numbers	Color
00	White
01	Yellow
04	Orange
05	Blue
07	Green
08	Red
09	Brown
11	Fluorescent Yellow
13	Fluorescent Yellow-Green
14	Fluorescent Orange
42	4" LEFT Orange Pre-Striped Barricade
43	4" RIGHT Orange Pre-Striped Barricade
44	6" LEFT Orange Pre-Striped Barricade
45	6" RIGHT Orange Pre-Striped Barricade

† OmniCube is the exception and leads with the number 11

The following Warranty is limited to North America.

WARRANTY

Avery Dennison T-6000 & W-6000 prismatic retroreflective sheeting ("Product(s)") are warranted to be free from defects in material and workmanship for one (1) year from date of purchase (or the period stated on the specific product information literature in effect at time of delivery, if longer). It is expressly agreed and understood that Avery Dennison's sole obligation and Purchaser's exclusive remedy under this warranty, under any other warranty, express or implied, or otherwise, shall be limited to repair or replacement of defective Product without charge at Avery Dennison's plant or at the location of Product (at Avery Dennison's election), or in the event replacement or repairs is not commercially practical, to Avery Dennison's issuing Purchaser a credit reasonable in light of the defect in the Product.

Avery Dennison further warrants that Avery Dennison® T-6000 & W-6000 prismatic retroreflective sheeting will retain its effectiveness as a component of traffic control and guidance signs, and will meet the stated minimum values for coefficient of retroreflection ("Performance Warranty") as set forth in accordance with the following standards:

Warranty Period*	Minimum Percentage R_A Retained
1-7 years	80%
8-10 years	80%

* Performance Warranty Period for Work Zone products is one to three (1-3) years

Note: For transparent color screen printed areas using Avery Dennison supplied or approved inks or OL-2000 Overlay films on Avery Dennison® T-6500 white sheeting, values shall be a minimum of 70% of values in Table A

R_A percentage retained above apply to all entrance and observation angles in Table A, and shall be measured per ASTM E 810.

All measurements shall be made after cleaning according to Avery Dennison procedures.

PERFORMANCE WARRANTY

If within ten (10) years from the initial date of installation, the Product deteriorates due to natural causes to the extent that: 1) the Product fails to retain the minimum reflectivity values warranted for the ten (10) year period under the standard in force at the time of installation, or 2) the Product is ineffective for its intended purpose when viewed from a moving vehicle under normal daytime or nighttime driving conditions, Avery Dennison will furnish a replacement amount of like Product at no cost to enable the installed surface to be restored to its original effectiveness. If within seven (7) years of installation such deterioration occurs or the Product fails to retain the minimum seven (7) year reflectivity values, Avery Dennison will restore the installation surface to its original effectiveness at no cost for materials or labor.

CONDITIONS.

This warranty shall be effective only if all of the following conditions are met:

Fabrication and/or installation must occur within one (1) year from the date of purchase.

The failure must have resulted solely from a manufacturing defect or deterioration of the Product due to natural causes under the Performance Warranty. Without limiting the generality of the foregoing, there is no warranty for the failure of the sheeting due to improper sign fabrication, storage, handling, installation, maintenance, failure of the sign substrate, vandalism or mischief. Slight color fading, cracking, chalking, edge lifting, or slight reduction in gloss or reflectivity will not materially detract from appearance and does not constitute a breach of warranty.

Avery Dennison has published instructional bulletins pertaining to the storage, handling, and cleaning of Product, approved substrates, and application procedures (collectively, the "Procedures"). The Product must have been processed and applied to blank, clean material in accordance with the Procedures, as such may be amended from time to time. Avery Dennison reserves the right to reject any warranty claim where the fabricator or installer cannot satisfactorily prove or demonstrate that the Avery Dennison procedures were utilized. The date of installation, warranty registration, and claim procedures established by Avery Dennison must be followed, and failure to follow such procedures shall void this warranty. Replacement Product carries only the unexpired warranty portion of the Product it replaces. The Product must be properly stored and applied within the shelf-life as stated in the applicable Avery Dennison Product Data Sheet including adhesive and other material product data sheets.

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Avery Dennison® T-6000 & W-6000 HIP Series

High Intensity Microprismatic Retroreflective Film

Issued: April 2011 Revision 1

Characteristics:

Property	*Value*	*Instructional Bulletins*
Shelf-Life	1 year from date of purchase when stored at the following conditions; 65°-75°F (18°-24°C) and 50% ± 5% R.H.	#8.00
Typical film Caliper	18 – 19 mils (457 – 483µ) Orange: 17 – 18 mils (432 – 457µ)	NA
Min. Application Temperature	65° F (18° C)	#8.10
Service Temperature	-10°F to +150°F (-23°C to + 65°C)	#8.00
Screen Printing	Long term durability of screen printing in combination with HIP series sheeting is warranted when used with approved inks and overlays. See Page 7.	#8.30 #8.55
Inkjet Printing	User assumes responsibility for fitness of use for this converting method. Long term durability of inkjet printing in combination with HIP series sheeting is not warranted.	#8.55
Thermal Transfer Printing	Long term durability of Thermal Transfer Printing in combination with any HIP series sheeting is warranted. Refer to Instructional Bulletin	#8.60

ADDITIONAL LIMITATIONS

Unintended Use: This warranty only applies to Product that is used by professional converters and installers for the defined end uses and in the combinations described in the applicable Avery Dennison Product Data Sheets and Instructional Bulletins. For any other use, the user is responsible for determining the suitability of the Product, and for any and all risk or liability associated with that use or application, and the user agrees to indemnify, defend and hold harmless Avery Dennison for any claims, losses, damages, judgments, expenses and/or expenses, including attorneys fees, resulting from such use or application. This warranty is expressly conditioned on the Product being processed by professional converters or installers in accordance with the Avery Dennison recommended written processing instructions, and being applied to properly prepared surfaces and cleaned and maintained in accordance with recommended Avery Dennison procedures. It is the converters, installers or other users responsibility to perform incoming raw material quality inspections, to assure proper surface preparation and that approved application procedures are followed, to retain converted samples, and to immediately cease using and notify Avery Dennison and/or its authorized agent or distributor of any Product, Materials and/or finished Product discovered to be (or reasonably capable of being discovered to be) defective.

Misuse and Force Majeure: Avery Dennison has no obligations or liability under this warranty with respect to Product that has been altered, modified, damaged, misused, abused, subject to accident, neglected or otherwise mishandled or improperly processed or installed. Product is not warranted against premature failure caused by chemical, environmental or mechanical means such as, but not limited to, vandalism, cleaning solutions, paints, solvents, moisture, temperature, mechanical washing equipment, engine fuel spills, engine exhaust, steam, organic solvents or other spilled chemicals pollutants, including industrial and volcanic ash. Damage from fire, structural failure, lightning, accidents, and other force majeure events are not covered by this warranty.

Third Party Product: Avery Dennison assumes no responsibility for any injury, loss or damage arising out of the use of a product that is not of our manufacture. Where installer or converter uses or reference is made to a commercially available product, made by another manufacturer, it shall be the responsibility of the user, installer or converter to ascertain the precautionary measures for its use outlined by the manufacturer.

The remedies provided under this warranty are exclusive. In no event shall Avery Dennison be responsible for any direct, indirect, incidental or consequential damages or specific relief whether foreseeable or not, caused by defects in such Product, whether such damage occurs or is discovered before or after replacement or credit, and whether or not such damage is caused by Avery Dennison's negligence. In no event shall Avery Dennison's liability hereunder exceed the remedies specifically set forth in this warranty. Avery Dennison's liability shall be limited, at Avery Dennison's option, to the purchase price, replacement of the defective Product and in some cases when authorized by Avery Dennison the repair and replacement of the defective Product.

THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHERS. ANY AND ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED. NO WAIVER, ALTERATION, ADDITION OR MODIFICATION OF THE FOREGOING CONDITIONS SHALL BE VALID UNLESS MADE IN WRITING AND MANUALLY SIGNED BY AN OFFICER OF AVERY DENNISON.

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Avery Dennison® T-6000 & W-6000 HIP Series
High Intensity Microprismatic Retroreflective Film

Issued: April 2011

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Converting Information:

The following Avery Dennison literature will provide information to the user for proper application, storage, and other requirements. Find the latest information on the Avery Dennison website, www.reflectives.averydennison.com. We encourage you to check our website periodically for updates.

Approved screen printing inks, overlays, thermal transfer ribbons:

Supplier	*Series*	*System*	*Instructional Bulletins*
Avery Dennison	4930 Inks	1 Part Solvent	#8.40
Avery Dennison	UVTS Nazdar	UV	#8.38
Avery Dennison	OL-2000	Acrylic Overlay	#8.01, #8.10, #8.25
Avery Dennison	OL-1000	Anti-Graffiti	#8.01, #8.10
Matan	DTS	Thermal Transfer	#8.60

Instructional Bulletins:

Film Care & Handling	#8.00
Substrate Requirements	#8.01
Application Techniques for PS Film	#8.10
Cutting Methods	#8.20
Computer Sign Cutting	#8.25
Screen Preparation	#8.30
Troubleshooting Printing & Processing	#8.34
UVTS Nazdar Inks	#8.38
4930 Series Inks	#8.40
Ink Recommendations Guide	#8.55
Matan Thermal Transfer Printing	#8.60

Substrates:

The application of Avery Dennison HIP Series sheeting is limited to properly prepared substrates which differ by product. For traffic products and W-6504, application is limited to properly prepared Aluminum. For products in the W-6100 line, application is limited to properly prepared plastic. For products in the W-6200 line, application is limited to properly prepared wood. Users are urged to carefully evaluate, under actual use conditions, any film application to other substrates. Failure of film caused by other substrates, materials, contamination, or improper surface preparation is not the responsibility of Avery Dennison. See Instruction Bulletin #8.01 for full details on substrate requirements.

DEFINITIONS

Durability: means that the Product in a finished graphic, panel or sign situated outdoors, subject to the limitations herein and Avery Dennison Product Data Sheets and Instructional Bulletins, and applied to recommended surfaces, will not deteriorate excessively such that the finished sign, panel or graphic is ineffective for its identification when viewed under normal conditions from the intended viewing distance.

Outdoor Durability: is based on normal middle European and central North American outdoor exposure conditions and application to recommended surfaces. Actual performance life will depend on a variety of factors, including but not limited to substrate preparation, exposure conditions and maintenance of the Product and finished graphic, panel or sign. In case the finished graphics, panel or sign is in areas of high temperatures or humidity, in industrially polluted areas or other areas with air laden particulate matter, and/or in high altitudes, Outdoor Durability may be reduced. Please see your local Avery Dennison representative for changes to warranties based on such localized conditions.

Vertical Exposure: means that the face of the finished graphic is ±10° from vertical.

Non-Vertical Exposure: means that the face of the finished graphic is greater than 10° from vertical and greater than 5° from horizontal. Retroreflective films are not warranted for this exposure.

Flat surfaces: means a two dimensional flat surface without protruding objects.

Weathering Effects: Some degradation of Product performance over time is considered normal wear. Slight color fading, chalking, edge lifting, or slight reduction in gloss or reflectivity due to normal wear exposure and other natural weathering, environmental or other conditions or damage caused by tornadoes, hurricanes, wind, excessive ice buildup or extraordinary frozen particulate conditions, large hail stones or other acts of God, do not constitute a breach of warranty or give rise to any liability by Avery Dennison.

Printing, Curing and Ink Defects: Ink contaminations, failures or other defects, or other failures due to improper printing conditions or settings including, but not limited to, unsuitable color calibration, incorrect ICC color profile or incompatible printing, do not constitute a breach of warranty. Product failure caused by ink over-saturation, excessive or under curing, failure of ink to render desired colors on Product, or other treatment or processing errors are not warranted.

Adhesion to Application Surfaces: This warranty does not cover the Product if the application surface is not properly prepared; nor does the warranty cover the Product or damage to the substrate because the layers of the substrate separate due to a lower bond between those layers than the bond between the Product and the top layer of the substrate, or surfaces which subsequently crack, peel, outgas, or become damaged beneath the Product

INDEPENDENT TESTING REQUIRED

All statements, technical information and recommendations about Avery Dennison products are based upon tests and information believed to be reliable but do not constitute a guarantee or warranty of any kind. All Avery Dennison products are sold with the understanding that Purchaser has independently determined the suitability of such products for its intended and other purposes.

Graphics and Reflective Solutions
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AVERY DENNISON
www.reflectives.averydennison.com
AnswerLine: 800-231-4654

High Intensity Prismatic Reflective Sheeting

Series 3930 with Pressure Sensitive Adhesive

Product Bulletin 3930 **August 2008**

Replaces PB 3930 dated Sept. 2006

Description

3M™ High Intensity Prismatic Reflective Sheeting Series 3930 is a non-metalized micro-prismatic lens reflective sheeting designed for production of reflective durable traffic control signs, work zone devices and delineators that are exposed vertically in service. Applied to properly prepared sign substrates, 3M high intensity prismatic sheeting provides long-term reflectivity and durability. Series 3930 sheeting is available in the following colors.

Color	Product Code
White	3930
Yellow	3931
Red	3932
Orange	3934
Blue	3935
Green	3937
Brown	3939

Photometrics

Daytime Color (x,y,Y)

The chromaticity coordinates and total luminance factor of the retroreflective sheeting conform to Table A.

Color Test

Conformance to standard chromaticity (x,y) and luminance factor (Y, %) requirements shall be determined by instrumental method in accordance with ASTM E 1164 on sheeting applied to smooth aluminum test panels cut from Alloy 6061-T6 or 5052-H38. The values shall be determined on a HunterLab ColorFlex 45/0 spectrophotometer. Computations shall be done for CIE Illuminant D65 and the 2° standard observer.[1]

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

Table A - CIE Chromaticity Coordinate Limits* for new sheeting

	1		2		3		4		Limit Y (%)	
Color	x	y	x	y	x	y	x	y	Min.	Max
White	.303	.300	.368	.366	.340	.393	.274	.329	40	-
Yellow	.498	.412	.557	.442	.479	.520	.438	.472	24	45
Red	.648	.351	.735	.265	.629	.281	.565	.346	3	12
Orange	.558	.352	.636	.364	.570	.429	.506	.404	14	30
Blue	.140	.035	.244	.210	.190	.255	.065	.216	1	10
Green	.026	.399	.166	.364	.286	.446	.207	.771	3	9
Brown	.430	.340	.610	.390	.550	.450	.430	.390	1	6

* The four pairs of chromaticity coordinates deteremine the acceptable color in terms of the CIE 1931 standard colormetric system measured with standard illuminant D65.

Coefficients of Retroreflection (R_A)

The values in Table B are minimum coefficients of retroreflection expressed in candelas per lux per square meter (cd/lux/m²).

Test for Coefficients of Retroreflection

Conformance to coefficient of retroreflection requirements shall be determined by instrumental method in accordance with ASTM E-810 "Test Method for Coefficient of Retroreflection of Retroreflective Sheeting" and per E-810 the values of 0° and 90° rotation are averaged to determine conformance to the R^A limits in Table B.

Table B - Minimum Coefficient of Retroreflection R^A for new sheeting (cd/lux/m²)

-4° Entrance Angle[2]

	Observation Angle[1]	
	0.2°	0.5°
White	560	200
Yellow	420	150
Red	84	30
Orange	210	75
Green	56	20
Blue	28	10
Brown	17	6

30° Entrance Angle[2]

	Observation Angle[1]	
	0.2°	0.5°
White	280	100
Yellow	210	75
Red	42	15
Orange	105	37
Green	28	10
Blue	14	5
Brown	8.4	3

[1]Observation (Divergence) Angle - The angle between the illumination axis and the observation axis.

[2]Entrance (Incidence) Angle - The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

R_A for Screenprinted Colors and Overlay Films

For screenprinted transparent color areas on white sheeting, or white sheeting covered with 3M™ ElectroCut™ Film Series 1170 when processed according to 3M recommendations, the ratios of the R_A for the color to the R_A for the white shall be no less than 70% of the R_A listed for the integral color in Table B and the colors shall conform to Table A on page 1.

Adhesive

Series 3930 sheeting has a pressure-sensitive adhesive that is recommended for room temperature application. Room temperature application is defined as 65°F (18°C) or higher.

Test Methods of Adhesive and Film

Standard Test Panels

Unless otherwise specified, the reflective sheeting shall be applied according to the manufacturer's recommendations to smooth 0.063 inches (1.6mm) minimum thickness 6061-T6, 5052-H38 or equivalent aluminum panels that have been degreased and lightly acid etched. Lack of contamination of test panels must be confirmed by passing the water break test and tape snap test as described in 3M Information Folder 1.7.

Properties

Standard Conditioning: All mounted and unmounted test specimens shall be conditioned for 24 hours hours at 73°F +/- 2°F (23°C + 1°C) and 50% +/- 4% R.H. before testing.

1. Adhesion

Test Weight 1-3/4 lbs. (0.8 kg) Test Method - Apply 4 inches (10cm) of 1 inch x 6 inch (2.54x15cm) strip to panel and condition, face panel down and suspend test weight from free end. Requirement - Not more than 2 inches (5.0cm) of peel in five minutes.

2. Impact Resistance

Test Method - Apply sheeting to a standard panel 3 inch x 6 inch (7.6x15.2cm) and condition. Subject sheeting to a 50-inch pound (5.7Nm) impact in accordance with ASTM D-2794. Requirement - No separation from panel or cracking outside immediate impact area.

3. Shrinkage

Test Method - Following conditioning of 9 inch x 9 inch samples, remove liner, place specimen on flat surface with adhesive side up. Requirement - Shrinkage not greater than 1/32 inches (0.8mm) in 10 minutes or more than 1/8 inches (3.2mm) in 24 hours in any dimension.

4. Flexibility

Test Method - Following conditioning of 1 inch x 6 inch sample, remove liner and dust adhesive with talc. At standard conditions, holding the ends of the sample, bend in one second around 1/8 inch (3.2mm) mandrel with adhesive side facing mandrel. Requirement - No cracking, peeling or delamination.

5. Gloss

Test Method - Test in accordance with ASTM D523 using an 85° glossmeter. Requirement - Rating not less than 50.

Sign Fabrication Methods

Application

3M high intensity prismatic sheeting series 3930 incorporates a pressure sensitive adhesive and should be applied to the sign substrate at room temperature 65°F (18°C) or higher by any of the following methods:

Mechanical squeeze roll applicator - Reference 3M Information Folder 1.4 (Room temperature application)

Application to extrusions requires heat directed at the next-to-last edge roller. Cracking or edge lifting may occur if the top film is not sufficiently softened.

Hand squeeze roll applicator - Reference 3M Information Folder 1.6

Hand Application

Hand application is recommended for legend and copy only. Application of sheeting for complete signs or backgrounds must be done with a roll laminator, either mechanical or hand. See 3M Information Folder 1.5 for more details.

Hand applications will show some visual irregularities that are objectionable to aesthetically critical customers. These are more noticeable on darker colors. To obtain a close-up uniform appearance, a roll laminator must be used.

All direct applied copy and border MUST be cut at all metal joints and squeegeed at the joint.

Splices

Series 3930 sheeting should be butt spliced when more than one piece of sheeting is used on one piece of substrate. The sheeting pieces should not touch each other at the splice and a gap of up to 1/16 inch is acceptable. This is to prevent buckling as the sheeting expands in extreme temperature/humidity exposure. If the visual appearance of the splice is important or a slight gap is undesirable, the following procedures must be followed:

1. Overlap the sheeting at least one inch, with or without the liner attached.
2. Using a straight edge and a sharp utility knife, cut through both layers of reflective sheeting.
3. Peel back and remove cut remnants. If liner was left on, remove and roll down remaining sheeting.
4. Seal edge with thinned 3M™ Process Color 880I Clear using a fine artist paintbrush.

Double Faced Signs - Series 3930 sheeting on the first side must be protected by damage from the steel bottom roll of squeeze roll applicators with FR-2 sponge rubber and SCW 568.

Substrates

For traffic sign use, product application is limited to properly prepared aluminum (see 3M Information Folder 1.7). Extrusions can be wrapped or trimmed, and flat panel signs are to be carefully trimmed so that sheeting from adjacent panels do not touch on the assembled signs. Users are urged to carefully evaluate all other substrates for adhesion and sign durability. Series 3930 sheeting is designed primarily for application to flat substrates. Any use that requires a radius of curvature of less than five inches should also be supported by rivets or bolts. Plastic substrates are not recommended where cold shock performance is essential. Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M.

Screen Processing

Series 3930 sheeting may be screen processed into traffic signs before or after mounting on a sign substrate, using 3M Process Colors Series 880I (see Product Bulletin 880I) or Series 880N (see Product Bulletin 880N). Series 880I or 880N process colors can be screened at 60-100°F (16-38°C) at relative humidity of 20-50%. A PE 157 screen mesh with a fill pass is recommended. See Information Folder 1.8 for details. Use of other process colors series is not recommended. 3M assumes no responsibility for failure of sign face legends or backgrounds that have been processed with non-3M process colors or 3M process colors other than those listed above.

Care should be taken to avoid flexing Series 3930 sheeting before and especially after screening to eliminate the possibility of cracking from improper handling techniques.

Cutting and Matching

The sheeting may be hand cut or die cut one sheet at a time, and band sawed or guillotined in stacks.

Series 3930 sheeting can be hand cut from either side with a razor blade or other sharp hand tool. Like all reflective sheetings, when two or more pieces are used side by side on a sign, they must be matched to assure uniform day color and night appearance.

Cutting equipment such as guillotines and metal shears, that have pressure plates on the sheeting when cutting, may damage the optics. Padding the pressure plate and easing it down onto the sheets being cut will significantly reduce damage.

Maximum stack height for cutting Series 3930 sheeting is 1-1/2 inches or 50 sheets. Details on cutting can be found in 3M Information Folder 1.10.

Multi-piece signs should have all panels or pieces oriented identically for uniform appearance under all viewing conditions (arrow and the seal pattern in the same direction).

Edge sealing Series 3930 sheeting is generally not required. Following extended exposure, airborne dust particles may become trapped within the row of cut cells along the sheeting edge. This should have no adverse effect on sign performance. If the user chooses to edge seal, series 880I process color should be used.

Cleaning

Signs that require cleaning should be flushed with water, then washed with a detergent solution and bristle brush or sponge. Avoid pressure that may damage the sign face. Flush with water following washing. Do not use solvents to clean signs. See 3M Information Folder 1.10.

Storage and Packaging

Series 3930 sheeting should be stored in a cool, dry area, preferably at 65-75°F (18-24°C) and 30-50% relative humidity and should be applied within one year of purchase. Rolls should be stored horizontally in the shipping carton. Partially used rolls should be returned to the shipping carton or suspended horizontally from a rod or pipe through the core. Unprocessed sheets should be stored flat. Finished signs and applied blanks should be stored on edge. Screen processed signs must be protected with the adhesive liner or SCW 568 slipsheet paper. Place the glossy side of the slipsheeting against the sign face and pad the face with closed cell packaging foam. Double-faced signs must have the glossy side of the slipsheet against each face of the sign.

Unmounted screened faces must be stored flat and interleaved with SCW 568 slipsheet, glossy side against the sign face. Packages of finished sign faces must include sufficient nylon washers for mounting. Avoid banding, crating, or stacking signs. Package for shipment in accordance with commercially accepted standards to prevent movement and chafing. Store sign packages indoors on edge.

Panels or finished signs must remain dry during shipment and storage. If packaged signs become wet, unpack immediately and allow signs to dry.

See Information Folder 1.11 for instructions on packing for storage and shipment.

Installation

Nylon washers are recommended between the heads of all twist fasteners (such as screw heads, bolts, or nuts) and the sheeting to protect the sheeting from the twisting action of the bolt heads.

Health and Safety Information

Read all health hazard, precautionary and first aid statements found in the Material Safety Data Sheet, and/or product label of chemicals prior to handling or use.

General Performance Considerations

The durability of 3M high intensity prismatic reflective sheeting series 3930 will depend upon substrate selection and preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance.

Maximum durability of Series 3930 sheeting can be expected in applications subject to vertical exposure on stationary objects when processed and applied to properly prepared aluminum according to 3M recommendations provided in 3M Information Folder 1.7 on Sign Substrate Surface Preparation.

The user must determine the suitability of any nonmetallic sign backing for its intended use.

Applications to unprimed, excessively rough or non-weather-resistant surfaces, or exposure to severe or unusual conditions can shorten the performance of such applications. Signs in mountainous areas that are covered by snow for prolonged periods may also have reduced durability.

3M process colors, when used according to 3M recommendations, are generally expected to provide performance comparable to colored reflective sheeting, except for certain lighter colors, such as yellow, gold, or heavily toned colors or blends containing yellow or gold, whose durability depends on how much of each color is used.

Dilution of color and atmospheric conditions in certain geographic areas may result in reduced durability.

3M™ ElectroCut™ Film Series 1170 can be expected to perform satisfactorily for the life of the sign when direct applied to series 3930 sheeting.

Warranty

3M warrants that 3M™ High Intensity Prismatic Reflective Sheeting Series 3930 sold by 3M to be used as components for traffic control and guidance signs in the United States and Canada will remain effective for its intended use and meet the stated minimum values for coefficient of retroreflection for ten years, subject to the following provisions in:

Table C
Percentage of Table B Initial R_A Minimums Guaranteed Over 10 Year Warranty Period (Colors: white, yellow, red, green and blue)

Warranty Period	Minimum Percentage R_A Retained
1-7 Years	80%
8-10 Years	70%

R_A percentage retained above apply to all entrance and observation angles presented in Table B, and shall be measured per ASTM E 810.

All measurements shall be made after cleaning according to 3M recommendations. If a high intensity grade prismatic sign surface is processed and applied to sign blank materials in accordance with all 3M application and fabrication procedures provided in 3M's product bulletins, information folders, and technical memos (which will be furnished to the agency upon request), including the exclusive use of 3M matched component systems, process colors, clear coatings, electronic cuttable films, protective overlay films, and recommended applications equipment; and

If the sign deteriorates due to natural causes to the extent that: 1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions by a driver with normal vision, or 2) the coefficient of retroreflection after cleaning is less than the minimums specified in Table C, 3M's sole responsibility and purchaser's and user's exclusive remedy shall be:

If the failure occurs within the first 7 years from the date of fabrication, 3M will, at its expense, restore the sign surface to its original effectiveness. If the failure occurs within the 8th through the 10th year from the date of fabrication, 3M will furnish the necessary amount of high intensity prismatic sheeting to restore the sign surface to its original effectiveness.

Warranty for 3934 Sheeting

3M warrants that 3M™ High Intensity Prismatic Reflective Sheeting 3934 Orange sold by 3M to be used as components for traffic control devices used in work zones in the United States and Canada will remain effective for its intended use and meet the stated minimum values for coefficient of retroreflection for three years, subject to the following provisions:

Minimum Coefficient of Retroreflection Candelas per Foot Candle per Square Feet Candelas per Lux per Square Meter (0.2° observation and -4° entrance)*

Sheeting Color	Min. Coeff. of Retroreflection (Three Years)
Orange	80

*All measurements shall be made after sign cleaning according to 3M recommendations and in accordance with ASTM E 810 "Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting."

If a high intensity prismatic sign surface is processed and applied to sign blank materials in accordance with all 3M application and fabrication procedures found in 3M's product bulletins, information folders and technical memos (which will be furnished to the agency upon request), including the exclusive use of 3M matched component systems, process colors, clear coatings, electronic cuttable films, protective overlay films, and recommeneded application equipment; and

If the sign deteriorates due to natural causes to the extent that: 1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions by drivers with normal vision, or 2) the coefficient for retroreflection is less than the minimum herin specified, 3M's sole responsibility and purchaser's and user's exclusive remedy shall be that 3M will provide pro-rata replacement of the 3M materials:

If failure occurs within the first year from the date of fabrication, 3M will at its expense, restore the sheeting surface to its original effectiveness. If failure occurs in the second year, two-thirds of the sheeting will be replaced. If failure occurs in the third year, one-third of the sheeting will be replaced.

Conditions

Such failure must be solely the result of design or manufacturing defects in the 3M high intensity prismatic reflective sheeting and not of outside causes such as: improper fabrication, handling, maintenance or installation; use of process colors, thinners, coatings, or overlay films and sheetings not made by 3M; use of application equipment not recommended by 3M; failure of sign substrate; exposure to chemicals, abrasion and other mechanical damage from fasteners used to mount the sign; sign burial; collisions, vandalism or malicious mischief.

3M reserves the right to determine the method of replacement. Replacement sheeting will carry the unexpired warranty of the sheeting it replaces. Claims made under this warranty will be honored only if the signs have been dated at the time of sheeting application, which constitutes the start of the warranty period. Claims made under this warranty will be honored only if 3M is notified of a failure within a reasonable time, reasonable information requested by 3M is provided, and 3M is permitted to verify the cause of the failure.

Limitation of Liability and Remedies

3M's liability under this warranty is limited to replacement or allowance as stated herein, and 3M assumes no liability for incidental or consequential damages such as lost profits, business or revenue in any way related to the product regardless of the legal theory on which the claim is based.

THIS WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OF FITNESS FOR A PARTICULAR PURPOSE, ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING OR OF PERFORMANCE, CUSTOM OR USAGE OF TRADE.

Literature Reference

IF 1.3 Instructions for Squeeze Roll Applicator

IF 1.5 Hand Application Instructions

IF 1.6 Instructions for Hand Squeeze Roll Applicator

IF 1.7 Sign Base Materials

IF 1.8 Color Application Instructions

IF 1.10 Cutting, Matching, Premasking, and Prespacing Instructions

IF 1.11 Storage Maintenance, and Removal Instructions

"Standard Highway Signs, As Specified in the Manual on Uniform Traffic Control Devices", U.S. Department of Transportation, Federal Highway Administration, 1979.

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