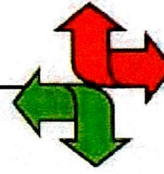


# Manual on Uniform Traffic Control Devices (MUTCD)

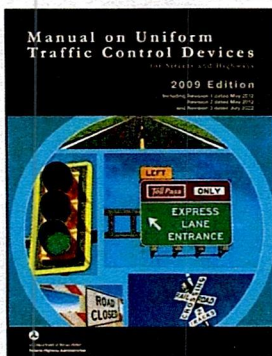


Knowledge

Knowledge

## 2009 MUTCD with Revisions 1, 2, and 3, July 2022

### Current MUTCD Edition



The **PDF version of the 2009 MUTCD with Revision Numbers 1, 2, and 3 incorporated, dated July 2022** is the official current edition.

The most current version of the MUTCD is the **2009 Edition with Revision Numbers 1, 2, and 3, dated July 2022**. The official version of the **2009 MUTCD with Revision Numbers 1, 2, and 3 incorporated** is the PDF version.

The 2009 MUTCD with Revision Numbers 1, 2, and 3 incorporated may also be viewed in HTML format, which is accessible to individuals with disabilities, per Section 508 of the Rehabilitation Act. **Disclaimer:** While every effort has been made to assure consistency between the PDF and HTML files posted on the MUTCD Web site, it is possible that the HTML files may not be totally identical in content to the PDF files. The PDF files constitute the official version of the MUTCD and always take precedence over any potentially conflicting MUTCD text or figures that may occur in the HTML files.

Interim Approvals Issued by FHWA

### Changes from the 2009 Edition

A document describing how the 2009 Edition with Revisions 1 and 2 incorporated (May 2012) differs from the 2009 Edition (December 2009) is available in PDF (19KB) and HTML.

### List of Known Errors in the 2009 MUTCD with Revisions 1 and 2 Incorporated

- [List of Known Errors in the 2009 MUTCD with Revisions 1 and 2 Incorporated, updated 1/12/2017 \(PDF version\)](#) (165KB)
- [List of Known Errors in the 2009 MUTCD with Revisions 1 and 2 Incorporated, updated 1/12/2017 \(HTML version\)](#)

**NOTE:** FHWA intends to correct these errors via a future rulemaking action. This list of known errors is provided solely for the information of MUTCD users and does not constitute changes to the MUTCD at this time.

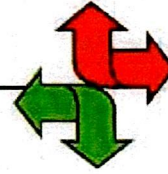
### Previous MUTCD Editions

To view previous editions of the MUTCD, including the 2009 Edition without Revisions 1, 2 and 3, please visit [Previous Editions of the MUTCD](#). For historical reference and to know what was in effect for a given date, these previous versions will be maintained on this Web site.

PDF files can be viewed with the [Acrobat® Reader®](#)



# Manual on Uniform Traffic Control Devices (MUTCD)



## Knowledge

### Knowledge

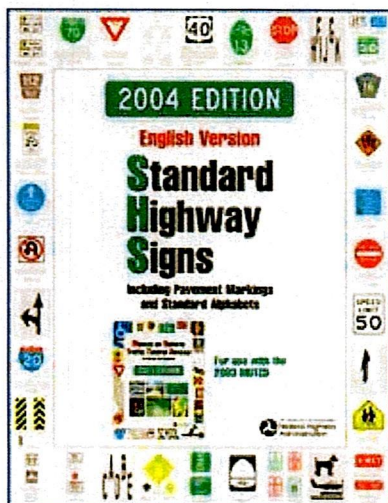
## Standard Highway Signs and Markings

### The 2009 MUTCD sign layouts are now available

The Federal Highway Administration has developed the design details of the new signs added in the 2009 Edition of the MUTCD and signs whose designs have been modified in the 2009 MUTCD. The new designs are provided in the form of a Supplement to the 2004 Edition of Standard Highway Signs.

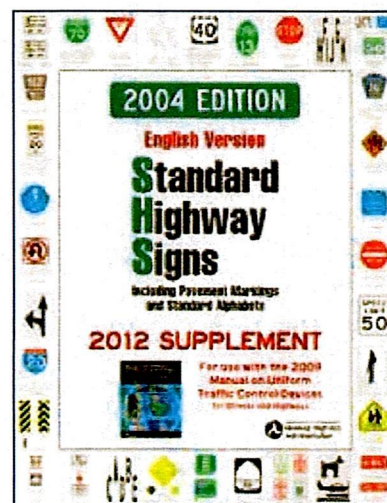
The contents of the 2012 Supplement will be incorporated into a new edition of *Standard Highway Signs*. This new edition will be released concurrently with the next edition of the MUTCD. This effort is programmed for 2017, however the timeline is subject to change. The new edition of *Standard Highway Signs* will contain the details for all signs and pavement markings in the MUTCD, expanded sign design guidelines, and details for symbolic traffic and lane-control signal indications.

### 2004 Edition, English Version, and 2012 Supplement



[2004 Edition](#)

[Known Errors in Standard Highway Signs, 2004 Edition](#)



[2012 Supplement to the 2004 Edition](#)

### How to use the 2012 Supplement with the 2004 Edition

These links represent the current version of Standard Highway Signs and the 2012 Supplement to the 2004 Standard Highway Signs. The 2012 Supplement contains the new and revised sign designs adopted in the 2009 Edition of the MUTCD. Where a sign design is included in the 2012 Supplement, its previous design in the 2004 Standard Highway Signs is superseded. Together, these two documents are a companion to the 2009 Edition of the MUTCD.

## NEW! FHWA Word Calculator for Highway Signs

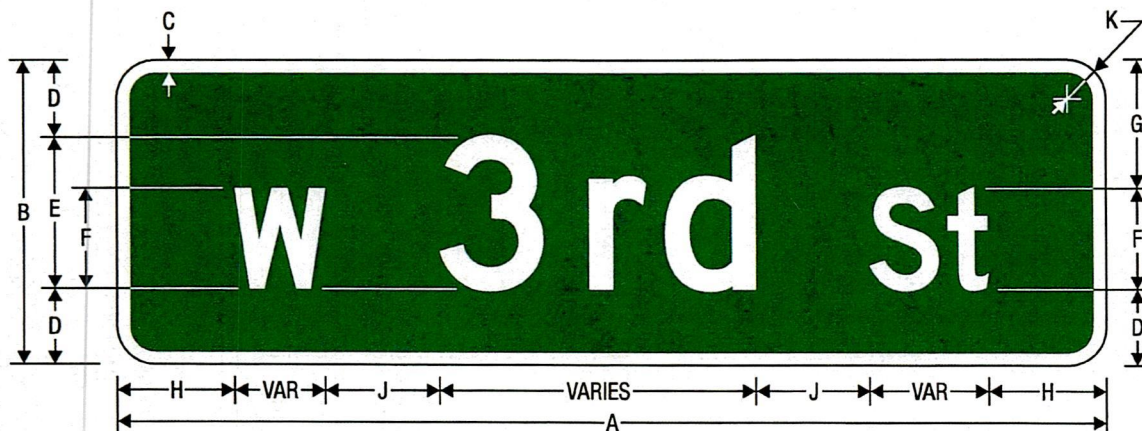
Try the [new design tool](#) to automatically determine the length of any traffic sign legend. Now, you can quickly and easily determine word lengths and estimate sign sizes based on the results. All the FHWA Standard Alphabet letter series—B, C, D, E, E(mod), and F—are supported for both upper- and lower-case letter forms. The tool can also be used to verify the output of sign design software programs.

## Vector-based PDF and EPS Sign Formats

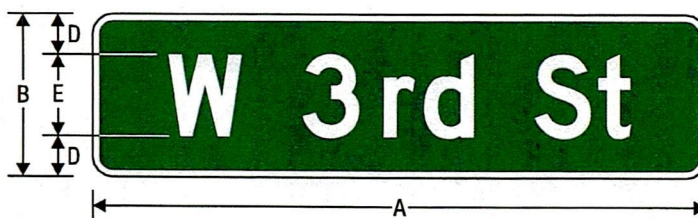
Undimensioned, full-size layouts for selected signs are provided for use by sign fabricators in the electronic fabrication process. These full-size layouts are made available in vector-based PDF and EPS formats that can be used directly with electronic vinyl cutting equipment.

- [Full-size PDF and EPS Files](#)





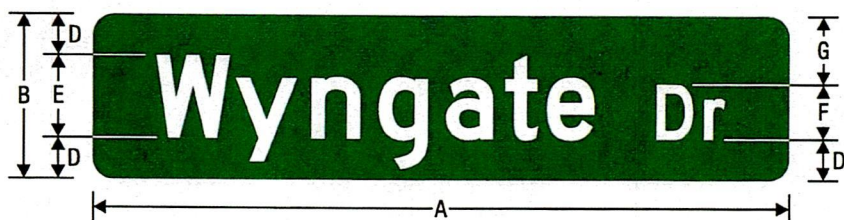
OR



D3-1 (Sheet 1 of 3)  
Street Name Sign



D3-1 – PRINCIPAL LEGEND WITH DESCENDING STROKES

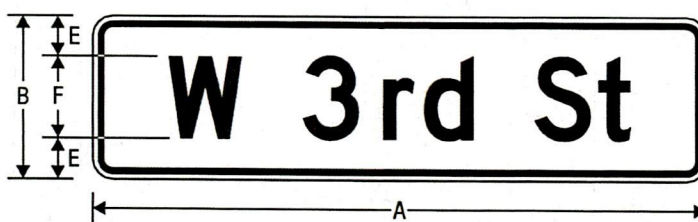
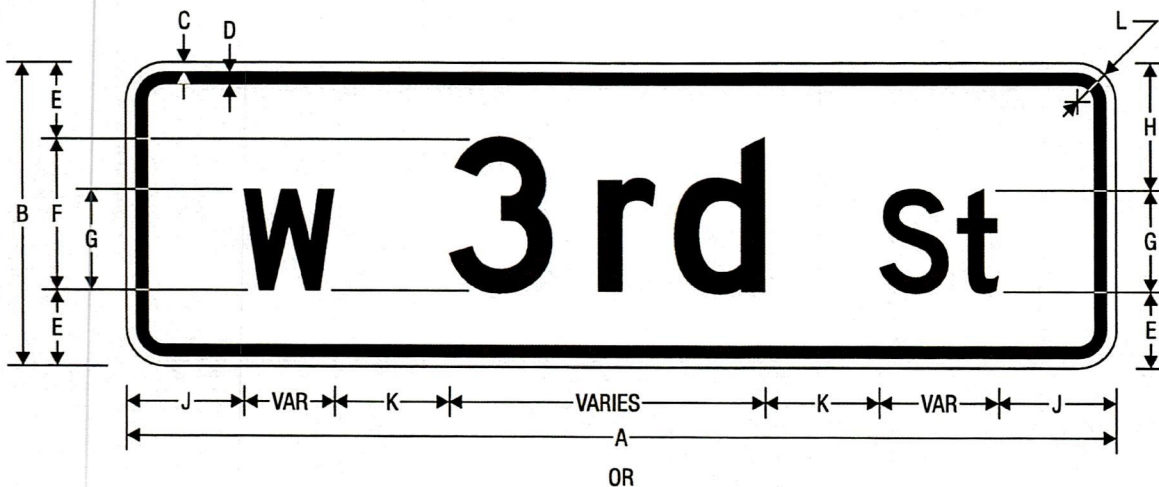


D3-1 – WITHOUT BORDER, PRINCIPAL LEGEND WITH OR WITHOUT DESCENDING STROKES

A	B	C	D	E	F	G	H	J	K	L	M	N
VAR	8	0.375	2	4 D	3 D	3	3 (MIN)	3	1	1.75	2.25	2.75
VAR	12	0.5	3	6 D	4 D	5	4.5 (MIN)	4.5	1.5	2.75	3.25	4.75
VAR	18	0.75	5	8 D	5.33 D	7.67	5.33 (MIN)	6	1.875	5	5	7.67
VAR	24	1	6	12 D	8 D	10	9 (MIN)	9	2.25	5.5	6.5	9.5

COLORS: LEGEND, BORDER – WHITE (RETROREFLECTIVE)  
BACKGROUND – GREEN (RETROREFLECTIVE)  
BACKGROUND (ALTERNATE) – BLUE OR BROWN (RETROREFLECTIVE)

X-XX



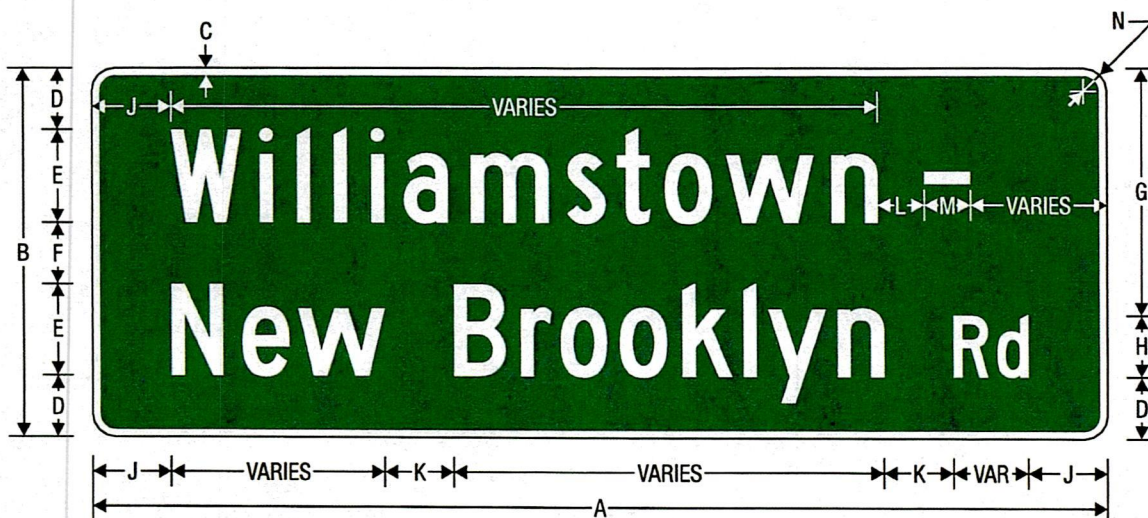
D3-1 (Sheet 2 of 3)  
Street Name Sign  
(ALTERNATE COLOR ARRANGEMENT)



D3-1 – PRINCIPAL LEGEND WITH DESCENDING STROKES  
(ALTERNATE COLOR ARRANGEMENT)

	A	B	C	D	E	F	G	H	J	K	L	M	N	P
	VAR	8	0.25	0.375	2	4 D	3 D	3	3 (MIN)	3	1	1.5	2.5	2.5
<b>C</b>	VAR	12	0.375	0.5	3	6 D	4 D	5	4.5 (MIN)	4.5	1.5	2.5	3.5	4.5
	VAR	18	0.5	0.75	5	8 D	6 D	7	5.33 (MIN)	6	1.875	4.5	5.5	6.5
	VAR	24	0.625	0.875	6	12 D	8 D	10	9 (MIN)	9	2.25	5	7	9

COLORS: LEGEND, BORDER – BLACK (NON-RETROREFLECTIVE)  
BACKGROUND – WHITE (RETROREFLECTIVE)



D3-1 (Sheet 3 of 3)  
Street Name Sign

	A	B	C	D	E	F	G	H	J	K	L	M	N
	VAR	15	0.375	2.25	4 C	2.5	9.75	3 C	3 (MIN)	3	2	2	1
<b>C</b>	VAR	24	0.5	4	6 C	4	16	4 C	4.5 (MIN)	4.5	3	3	1.5
	VAR	33	0.75	5.5	8 C	6	22.17	5.33 C	5.33 (MIN)	6	4	4	1.875
	VAR	48	1	8	12 C	8	32	8 C	9 (MIN)	9	6	6	2.25

COLORS: LEGEND, BORDER — WHITE (RETROREFLECTIVE)  
BACKGROUND — GREEN (RETROREFLECTIVE)  
BACKGROUND (ALTERNATE) — BLUE OR BROWN (RETROREFLECTIVE)

Transportation Safety Division

# 3M™ High Intensity Prismatic Reflective Sheeting Series 3930

Product Bulletin Series 3930  
February 2023

Replaces Product Bulletin Series 3930 Dated June 2021

## 1 Description

3M™ High Intensity Prismatic Reflective Sheeting Series 3930 (“**Sheeting**”) is a reflective prismatic sheeting designed for use in the production of durable reflective traffic control and guidance signs (“**Signs**”) that are exposed vertically in service.

For details of the features and benefits of Sheeting, please refer to the 3M Transportation Safety Division website (<http://www.3M.com/roadsafety/>).

The Sheeting is available in the following colors.

**Table 1.** Product codes by color.

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

## 2 Specifications

The Sheeting conforms to all current performance requirements of ASTM D4956 for Type III and Type IV retroreflective sheeting. Refer to section 7 for information regarding imaging of Sheeting.

## 3 System of Matched Components

For a complete list of matched components for the Sheeting, please see the [3M™ Sign Warranty Bulletin](#).

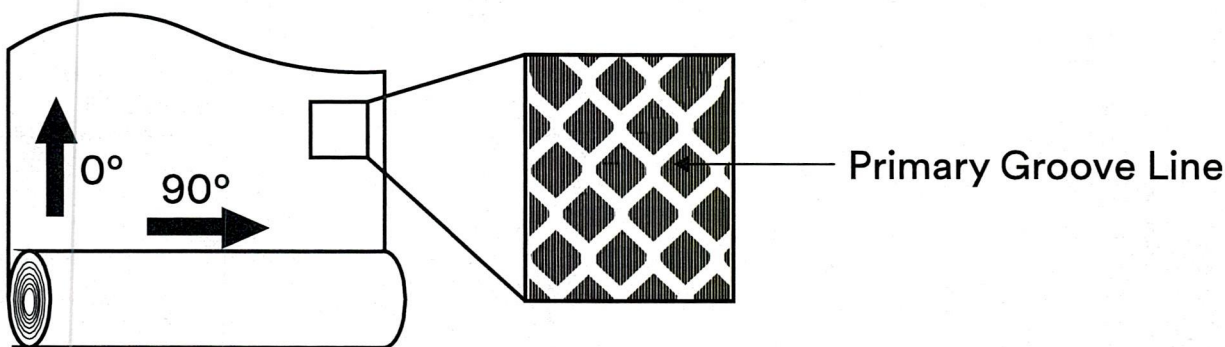
## 4 Physical Properties

### 4.1 Adhesive

Sheeting has a pressure-sensitive adhesive that is recommended for application at temperatures of 65 °F (18 °C) and higher. Meets ASTM D4956 Class I adhesive requirement.

### 4.2 Entrance Angularity Performance with Respect to Orientation

Sheeting has been designed to be an effective wide angle reflective sheeting regardless of its orientation on the substrate or the ultimate orientation of the Sign after installation. However, because the efficiency of light return from cube corner reflectors is not equal at all application orientations, especially at higher entrance angles, it is possible to get the widest entrance angle light return when the Sheeting is oriented in a particular manner. Sheeting orientation can be used to easily optimize high entrance angle (>50°) performance when it is required for a given Sign (e.g. “keep right” symbols). In such situations, the completed Sign should have the Sheeting positioned at the 0° orientation (downweb direction perpendicular to the road). When the “primary groove line” (which is oriented parallel to the flat sides of the diamond chain links) is vertical on the completed Sign, Sheeting is said to be in a 0° orientation. When the “primary groove line” is horizontal on the completed Sign, the Sheeting is said to be in a 90° orientation. See Figure 1 for details.



**Figure 1.** Primary groove lines used to define Sheeting orientation.

Unless a Sign's location and/or position calls for extra-wide entrance angularity performance or a specific installation direction is required in a customer specification, Signs and applied copy (letters, arrows, borders, and shields) can be fabricated and installed using the application orientation that most efficiently utilizes the reflective Sheeting.

**Note:** For multi-panel Signs, it is recommended that all background panels be applied with the Sheeting oriented in the same direction.

## 5 Substrates

Refer to [3M Information Folder 1.7](#) for surface preparation recommendations.

Sheeting has been designed primarily for application to flat substrates. Any application to a substrate with 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 required. **Sign failures caused by substrate failures or improper surface preparations are not the responsibility of 3M.**

## 6 Sign Fabrication Methods

### 6.1 Squeeze Roll Application

Sheeting should be applied to Sign substrates at temperatures of 65 °F (18 °C) and higher using either of the following methods:

**Mechanical squeeze roll applicator** – refer to [3M Information Folder 1.4](#). Applications to extrusions that are edge wrapped require sufficient softening of the Sheeting prior to edge wrapping. Softening can be accomplished by directing additional heat to the “next to last” edge roller. This practice may increase productivity and minimize cracking.

**Hand squeeze roll applicator** – refer to [3M Information Folder 1.6](#) for details.

Background and complete Sign applications of Sheeting must be performed using a roll laminator, either mechanical or hand driven.

### 6.2 Hand Application

Hand application is recommended for legend and copy only. Refer to [3M Information Folder 1.5](#) for more details.

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

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

### 6.3 Splices

Sheeting must be butt spliced when more than one piece of Sheeting is used on a single piece of substrate. Sheeting pieces should not touch one another. Avoiding overlap prevents the buckling that can occur as Sheeting expands under extreme temperature and humidity conditions.

### 6.4 Double Faced Signs

The Sheeting on the bottom side of a double faced Sign can be damaged if rolled through a squeeze roll applicator using an unprotected steel bottom roller. The use of a semi-soft flat sheet between the steel roller and the applied Sign face will protect the Sign face from damage. Use of a rubber mat, tag board, or cardboard is recommended.

## 7 Imaging

Sheeting may be processed into traffic Signs using the imaging methods described below. Compatibility is backed with a 3M™ MCS™ Warranty or 3M™ MCS™ Warranty for Traffic when the printing guidelines referred to in the Literature References of Section 15 are followed. See Section 13 of this document for more information regarding the warranties. 3M assumes no responsibility for the failures of Sign face legends or backgrounds that have not been processed according to the [3M Sign Warranty Bulletin](#).

### 7.1 Digital Imaging

Sheeting is compatible with 3M qualified latex inkjet printers and ink systems. Refer to [3M Information Folder 1.17](#) and [HP Large Format Printing Knowledge Center](#) for details. Use of 3M™ ElectroCut™ Film 1170C or 3M™ Premium Protective Overlay Film Series 1160i is required.

### 7.2 Screen Processing

Sheeting may be screen processed into traffic Signs using 3M™ Process Colors Series 880I or 3M™ Process Colors Series 880N before or after being mounted onto a substrate. Refer to [3M Information Folder 1.8](#) for details. Clear coating is neither required nor recommended. Use of process color series other than 880I or 880N is not recommended.

### 7.3 3M™ ElectroCut™ Film

3M™ ElectroCut™ Film Series 1170 may be used on Sheeting to provide transparent colored background copy for traffic control Signs. Refer to [3M Product Bulletin 1170](#) for fabrication procedures.

### 7.4 Applied Cut-Out Copy

Sheeting cut-out copy may be applied to Sheeting backgrounds to create Sign legends. Refer to [3M Information Folder 1.10](#) for more information.

## 8 Cutting

Sheeting may be cut into letters and shapes with heights of at least 3 inches and stroke widths of at least ½ inch. Smaller sizes are not recommended. Sealing the cut edges of Sheeting is not required.

### 8.1 Plotter Cutting

- 1 Flat bed plotters can be used to cut Sheeting and offer the most consistent and reliable performance.
- 2 Friction fed plotters can be used to kiss cut only. This is achieved using 600 grams of down force and a 60° cutting blade. Additional drive wheels may be needed to improve tracking. Alternatively, Sheeting can be cut from the liner side. To do so, the blade force and knife depth must be set to score, but not cut through, the top film. After scoring, break apart individual copy or apply premask to retain spacing.

### 8.2 Other Cutting Methods

Sheeting may be hand cut or die cut one sheet at a time. Cutting procedures can be found in [3M Information Folder 1.10](#).

## 9 Installation

Nylon washers are required when twist style fasteners are used to mount Signs.

## 10 Shelf-Life, Processing, Storage, Packaging, and Cleaning

Please refer to [3M Information Folder 1.11](#).

## 11 Durability

Please refer to [3M Information Folder 1.7](#). Periodic Sign inspection and regular Sign replacement are strongly recommended in order to help Sign owners establish their own effective service life expectations, beyond the warranty period.

## 12 Health and Safety Information

Read all health hazard, precautionary, and first aid statements found in the Safety Data Sheets (SDS), Article Information Sheets, and products labels of any materials for important health, safety, and environmental information prior to handling or use. To obtain SDSs and Article Information Sheets for 3M products, go to [3M.com/SDS](https://www.3M.com/SDS), contact 3M by mail, or for urgent requests call 1-800-364-3577.

## 13 Warranty Information

### 13.1 3M Standard Product Warranty

The Sheeting is warranted ("3M Standard Warranty") to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in this product bulletin. If the Sheeting is proven not to have met the 3M Standard Warranty on their shipment date, then a buyer's exclusive remedy, and 3M's sole obligation, at 3M's option, will be refund or replacement of the Sheeting.

### 13.2 3M™ MCS™ Warranty and 3M™ MCS™ Warranty for Traffic

For warranty on digitally printed Sheeting, please refer to the [3M Sign Warranty Bulletin](#).

### 13.3 Disclaimer

THE 3M WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE, OR ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING OR OF PERFORMANCE, CUSTOM, OR USAGE OF TRADE.

### 13.4 Limitation of Liability

Except for the limited remedy stated above, and except where prohibited by law, 3M will not be liable for any loss or damage arising from the Signs or any 3M product, whether direct, indirect, special, incidental, or consequential damages (including but not limited to lost profits, business, or revenue in any way), regardless of the legal theory asserted including warranty, contract, negligence, or strict liability.

## 14 Other Product Information

Always confirm that you have the most current version of the applicable product bulletin, information folder, or other product information from 3M's Website at <http://www.3M.com/roadsafety>.

## 15 Literature References

<a href="#">3M IF 1.4</a>	Instructions for Interstate Squeeze Roll Applicator
<a href="#">3M IF 1.5</a>	Hand Application Instructions
<a href="#">3M IF 1.6</a>	Hand Squeeze Roll Applicator
<a href="#">3M IF 1.7</a>	Sign Base Surface Preparation
<a href="#">3M IF 1.8</a>	Process Colors Series 880 and 900 Instructions for Use
<a href="#">3M IF 1.10</a>	Cutting, Premasking, and Prespacing
<a href="#">3M IF 1.11</a>	Sign Maintenance Management
<a href="#">3M IF 1.17</a>	User Guide 3M™ Reflective Sheeting and HP Latex 360/365 Printers
<a href="#">3M PB 880I</a>	3M™ Process Color Series 880I
<a href="#">3M PB 880N</a>	3M™ Process Color Series 880N
<a href="#">3M PB 1160</a>	Premium Protective Overlay Film
<a href="#">3M PB 1160i</a>	3M™ Premium Protective Overlay Film 1160i
<a href="#">3M PB 1170</a>	3M™ ElectroCut™ Film Series 1170
<a href="#">3M PB Slipsheeting</a>	3M™ Slipsheeting
<a href="#">3M Sign Warranty Bulletin</a>	
<a href="#">3M™ MCS™ Warranty for Traffic Matrix for ElectroCut™ Film Series 1170</a>	
<a href="#">3M™ MCS™ Warranty for Traffic Matrix for Screen Printed Signs</a>	
<a href="#">3M™ MCS™ Warranty for Traffic Matrix for Unimaged 3M™ Retroreflective Sheeting</a>	
<a href="#">3M™ MCS™ Warranty Matrix for HP Latex 360/365 Printers</a>	
<a href="#">3M™ MCS™ Warranty for Traffic Matrix HP 360-365</a>	
<a href="#">3M™ MCS™ Warranty Matrix for HP Latex 1500 Printer</a>	
<a href="#">3M™ MCS™ Warranty Matrix for Traffic for HP Latex 1500 Printer</a>	
<a href="#">HP 700, HP 800 Matrix</a>	
<a href="#">HP 700, HP 800 Matrix for Traffic</a>	

[HP Large Format Printing Knowledge Center](#)

ASTM Test Methods are available from ASTM International, West Conshohocken, PA.

## **For Information or Assistance**

**Call: 1-800-553-1380**

**In Canada Call:**

**1-800-3M HELPS (1-800-364-3577)**

**Internet:**

**<http://www.3M.com/roadsafety>**

3M, 3M Science. Applied to Life., ElectroCut, and MCS are trademarks of 3M. Used under license in Canada.  
All other trademarks are the property of their respective owners.

3M assumes no responsibility for any injury, loss, or damage arising out of the use of a product that is not of our manufacture. Where reference is made in literature to a commercially available product, made by another manufacturer, it shall be the user's responsibility to ascertain the precautionary measures for its use outlined by the manufacturer.

### **Important Notice**

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable at the time of this publication, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, or conditions express or implied. Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss, or damage, direct, indirect, special, or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his/her intended use, and user assumes all risk and liability whatsoever in connection therewith. Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller and manufacturer.



**Transportation Safety Division**  
3M Center, Building 223-3S-33  
St. Paul, MN 55144-1000 USA

Phone 1-800-553-1380  
Web [3M.com/roadsafety](http://3M.com/roadsafety)

Please recycle. Printed in USA © 3M 2023.  
All rights reserved. Electronic only