



Scotchlite™ Reflective Graphic Film

Series 680

Film 680-10

For Screen Printing

For Electrostatic or Screen Printing

Product Description

These are 7-mil, flexible, enclosed lens, retroreflective films that offer great versatility along with slideable, pressure-activated adhesive. These long-term durable films are designed for commercial vehicle, railroad and bus graphics, sign graphics, and striping on vertical, flat, curved or corrugated surfaces, with or without rivets. Use these films for screen printing or electrostatic printing.

Advantages

- Up to 9 year durability with up to 7 year 3M™ MCS™ Warranty on many applications
- Similar daytime and nighttime appearance that retains most of its reflectivity when wet
- Excellent angularity
- Unprocessed film resists fuel vapors or occasional spills
- Engineer grade film

Recommended Types of Graphics and End Uses

When constructed and used as described in this Bulletin, these types of graphics and end uses may be warranted by the 3M™ MCS™ Warranty. Please read the entire Bulletin for details.

- Vertical commercial vehicle, railcar and bus graphics
- Vertical commercial signs and striping
- Vertical indoor and outdoor signage

Limitations of End Uses

3M specifically does not recommend or warrant the following uses, but please contact us to discuss your needs or recommend other products.

Unsuitable End Uses for This Film

- Do not apply this film on:
 - Walls
 - Substrates with compound curves
 - Substrates that do not have a clean, smooth surface or have poor paint-to-substrate adhesion
 - Stainless steel
 - FRP with a Tedlar® coating
 - Flexible substrates
- Graphics made for automotive Original Equipment Manufacturers (OEM); contact 3M Automotive Division at 1-800-328-1684 for alternatives.

Compatible Products

3M Graphic Materials

This Bulletin provides details about the base film and construction options and warranty. Additional specific information about compatible products can be found in the Product and Instruction Bulletins listed in **3M Related Literature** at the end of this bulletin.

See the Warranty matrix to determine which Compatible Products are approved for your graphic construction.

Screen Printing

- 3M™ Screen Printing Ink Series 1900
- 3M™ Screen Printing UV Ink Series 9800
- 3M™ Scotchlite™ Screen Printing Ink Series 2900

Electrostatic Printing

- Scotchprint® Toner Series 8700/8800
- 3M™ Trident Transfer Paper

Graphic Protection Options

- 3M™ Screen Printing Gloss Clear 9800CL
- 3M™ Screen Print Gloss Clear 1920DR
- 3M™ Screen Print UV Gloss Clear 9720i
- 3M™ Screen Print Gloss Clear 9720UV
- 3M™ Scotchlite™ Screen Printing Gloss Clear 4430R
- 3M™ Scotchcal™ Luster Overlamine 8519
- 3M™ Scotchcal™ Luster Overlamine 8908
- 3M™ High Gloss Graffiti Resistant Overlamine 8912 ES *not for use on rivets*
- 3M™ Screen Print Clear 8920 ES *not for use on corrugations*

Other Products

- 3M™ Prespacing Tape SCPS-2
- 3M™ Premasking Tape SCPM-3
- 3M™ Premasking Tape SCPM-44X
- 3M™ Edge Sealer 3950

Characteristics

These are typical values for unprocessed product; processing may change the values. Contact your 3M representative for a custom specification.

Physical Characteristics

Characteristic	Value																																				
Material	Vinyl																																				
Thickness	With adhesive: 7 to 8 mils (0.18 to 0.20 mm)																																				
Adhesive type	Pressure-activated, slideable																																				
Adhesive color	Clear with silver underneath																																				
Liner	Polyethylene-coated paper																																				
Film colors & typical retroreflection	<p>At -4° entrance angle and 0.2° observation angle.</p> <table border="1"> <thead> <tr> <th>Film Number</th> <th>Color Name</th> <th>Typical Coefficient of Retroreflection</th> </tr> </thead> <tbody> <tr> <td>680-10</td> <td>White</td> <td>100</td> </tr> <tr> <td>680-14</td> <td>Orange</td> <td>20</td> </tr> <tr> <td>680-64</td> <td>Gold</td> <td>70</td> </tr> <tr> <td>680-71</td> <td>Yellow</td> <td>65</td> </tr> <tr> <td>680-72</td> <td>Red</td> <td>20</td> </tr> <tr> <td>680-75</td> <td>Blue</td> <td>10</td> </tr> <tr> <td>680-76</td> <td>Light blue</td> <td>10</td> </tr> <tr> <td>680-77</td> <td>Green</td> <td>20</td> </tr> <tr> <td>680-81</td> <td>Lemon yellow</td> <td>75</td> </tr> <tr> <td>680-82</td> <td>Ruby red</td> <td>15</td> </tr> <tr> <td>680-85</td> <td>Black</td> <td>30</td> </tr> </tbody> </table> <p>See page 8 for ASTM and NFPA standards for this film series.</p>	Film Number	Color Name	Typical Coefficient of Retroreflection	680-10	White	100	680-14	Orange	20	680-64	Gold	70	680-71	Yellow	65	680-72	Red	20	680-75	Blue	10	680-76	Light blue	10	680-77	Green	20	680-81	Lemon yellow	75	680-82	Ruby red	15	680-85	Black	30
Film Number	Color Name	Typical Coefficient of Retroreflection																																			
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Retroreflection Definition	<p>The typical coefficient of retroreflection defined is measured at a -4° entrance angle and a 0.2° observation angle. It is expressed in candle-power per foot-candle per square foot (candela/lux/square meter) per ASTM E 810.</p> <p>The entrance angle is formed by a light beam striking the surface at a point and a line that is perpendicular to the surface at the same point.</p> <p>An observation angle is formed by the light beam striking the reflective surface and returning to the observer. From 800 feet (249 meters), a motorist normally views a graphic at a 0.2° angle.</p>																																				
Chemical resistance	<ul style="list-style-type: none"> • Resists mild alkalis, mild acids, and salt • Excellent resistance to water (<i>not immersion</i>) • Resists occasional fuel spills 																																				
Flammability	Call 1-800-328-3908 for information																																				

Application Characteristics

Characteristic	Value
Finished graphic application recommendation	<p>Surface type: Flat, with/without rivets; moderate curves; corrugations</p> <p>Substrate type: Aluminum, FRP, paint</p> <p>Graphic orientation: Vertical only</p> <p>Application temperature: <i>air and substrate</i></p> <ul style="list-style-type: none"> • 50° to 100°F (10° to 38°C) flat surfaces without rivets • 55° to 100°F (13° to 38°C) flat, curved or corrugated surfaces with rivets <p>Application method: Dry</p>
Adhesion 24 hours after application	<p>Aluminum: 6.0 pounds/inch (1.1 kg/cm)</p> <p>FRP (Fiberglass Reinforced Plywood): 3.0 lb/inch (0.5 kg/cm)</p> <p>Painted aluminum panels: 4.5 pounds/inch (0.8 kg/cm)</p>
In use temperature range	-30° to +200°F (-34° to +93°C)

Definitions

Exposure

U.S. Vertical Exposure



face of graphic

The face of the graphic is +/- 10° from vertical.

U.S. Desert Southwest Exposure

Any outdoor graphic exposed to solar energy more than half of the daylight hours in Arizona, New Mexico and the desert areas of California, Nevada, Utah and Texas is subject to reduced warranties. A detailed map is available at 3Mgraphics.com under Warranties.

Graphic Types

Indoor Signs

Stationary graphics applied indoors and *not* exposed to the elements.

Outdoor Signs

Stationary graphics applied outdoors and exposed to the elements.

Railroad

Graphics applied on railroad cars but not railroad engines.

OEM

Labels and decorative graphics produced for and used by original equipment manufacturers.

Fleet Vehicle

Straight trucks, semi-tractors and trailers used in commercial fleets. Excludes air shields.

Standard Vehicle

Buses, vans, automobiles, recreational vehicles unless otherwise noted.

Graphic Construction

The products used to make a graphic, which may include film and/or flexible substrate, graphic protection, ink, printer and application tape.

Graphic Protection

Overlamine films or clear coats used to protect the graphic and/or change gloss.

Warranty Information

Warranty and Limited Remedy

The following is made in lieu of all other express or implied warranties, including any implied warranty of **merchantability** or fitness for a particular purpose or implied warranty arising out of a course of dealing, custom or usage of trade: all 3M products are warranted to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in this Product Bulletin. 3M will replace or refund the price of any 3M materials that do not meet this warranty within the specified time periods. These remedies are exclusive. **In no case shall 3M be liable for any direct, indirect, or consequential damages, including any labor or non-3M materials charges.**

See the *3M Graphics Market Center Warranty Brochure* at 3Mgraphics.com, which gives the terms, additional limitations of the warranty, if any, and limitations of liability.

Warranty Coverage Overview

Both the warranty coverage and the durability for each graphic is based on the user(s) reading and following all applicable and current 3M Product and Instruction Bulletins. 3M will honor the Warranted Durability stated in the Warranted Durability Table in the base film or substrate Product Bulletin that is current when the film was purchased. Warranted durabilities may be reduced and stipulations may apply for certain constructions and applications, as covered in this Bulletin.

3M™ MCS™ Warranty

Warranted Durability Table
for Finished Graphics
in a Standard U.S. Vertical Exposure

Finished graphics constructed as shown in the tables below are eligible for the MCS Warranty. For warranties for other exposures, see page 5.

Veh = Fleet, Standard and Recreational Vehicle Graphics
Rail = Railroad Graphics
Sign = Indoor and Outdoor Signs

Screen Printing

Warranted Durability in Years

All Film Colors

3M Ink	Series 2900					Series 1900			Series 9800				
	line color			4-color		line color			line color			4-color	
Graphic Protection	Veh	Rail	Sign	Veh	Sign	Veh	Rail	Sign	Veh	Rail	Sign	Veh	Sign
1920DR	7	5	5	5	5	7	7	7	—	—	—	—	—
4430R	7	5	5	5	5	7	5	5	—	—	—	—	—
9720i	7	5	5	5	5	7	5	5	7	5	5	5	5
9720UV	7	5	5	5	5	7	5	5	7	5	5	5	5
9800CL	—	—	—	—	—	—	—	—	5	5	5	5	5

Unprinted Film

	Graphic Protection	Veh	Rail	Sign
Warranted Durability	None	7	5	5
Expected Durability	None	9	5	5

For Unprinted Film only, both a Warranted Durability and Expected Durability is given. The film is covered by the MCS Warranty for the period described, but 3M testing shows that when unprinted, the film can be expected to perform satisfactorily for the extended period given.

Electrostatic Printing

White Film Only

3M Toner	8700	
Graphic Protection	Veh	Sign
8908	—	1
8519	5	5
8912	5	4
8920	5	4

Reduced Warranty for Graphics Exposed to Heat

Long exposure to continuous high heat decreases the performance life of this film by 2 years. High heat is a temperature above 150°F (65°C). It may occur in areas such as railroad locomotives, vehicle engine compartments, non-insulated tankers exposed to frequent internal steam cleaning, or compartments that carry hot cargo.

Fleet Labor Reimbursement

3M will reimburse 100% of the labor costs associated with the removal, remanufacture and reapplication of a **commercial fleet graphic only** to the extent that 3M determines such amount is reasonable and necessary in the circumstances. This labor cost reimbursement will be determined by 3M on a case-by-case basis taking into account the expected amount of labor needed to make such repairs and other considerations.

General Warranty Stipulations

These stipulations apply to graphics covered by the 3M™ MCS™ Warranty. Specific provisions of these stipulations are found in the *3M Graphics Market Center Warranty Brochure* at 3Mgraphics.com.

Reduced Warranted Durability

For Graphics NOT in a U.S. Vertical Exposure

Use the years indicated in the applicable Warranted Durability Table, starting on page 4, for your graphic construction and these formulas to determine reduced durabilities for the following graphic exposure.

If the Graphic Exposure is:	Use this Percentage of U.S. Vertical Exposure, Warranted Durability	Examples
Desert Southwest Vertical	70% (0.7)	0.7 x 5 years = 3.5 years
All other exposures	0	0

Abrasion and Loss of Gloss

Abrasion damage and loss of gloss are not covered by any 3M warranty. This is considered normal wear and tear.

Application to Glass

3M accepts no liability for glass breakage when using this film for window graphics. See Instruction Bulletin 5.1 for details.

Application Outside the U.S.

Contact the 3M organization for that country.

Graphics Made with Components Not Sold or Recommended by 3M

The 3M™ MCS™ Warranty does not cover finished graphics made with inks, film, graphic protection and/or application tapes that are not sold or recommended by 3M. The user is solely responsible for the graphic appearance, performance and durability of graphic constructions that include any other products.

Graphic Protection

Any graphic exposed to abrasive conditions (including vehicles), harsh cleaners or chemicals must include graphic protection in order to be warranted. Abrasion damage and gloss loss are not covered.

Rivets

This film will tent when applied over rivets. If the rivets are closely spaced, the film will bridge between rivets. Tented or bridged film may fail prematurely, which is not covered by any 3M warranty.

Factors that Affect Graphic Performance Life

The actual performance life of a graphic is affected by all of the following.

- The combination of graphics materials used
- Ink formulation
- Adequate ink drying or curing
- Selection, condition and preparation of the substrate
- Surface texture
- Application methods
- Angle and direction of sun exposure
- Environmental conditions
- Cleaning or maintenance methods

Screen Printing

Ink formulations and processing conditions can affect ink durability. Refer to the Product and Instruction Bulletins for your ink for limitations and proper usage.

- Ink series 1900 and some colors in ink series 9800 are opaque. Be aware that opaque ink can prevent the film from retroreflecting in the screen printed areas. Ink series 2900 and the transparent colors from ink series 9800 are good choices when retroreflection is important in the screen printed areas.
- For graphics subjected to fuel vapors or occasional spills, use screen printing ink series 2900 and clear 4430R.
- Oven dry the last color and the clear when using solvent-based inks on graphics needed for any corrugated application.

Electrostatic Printing

Refer to the 3M Related Literature section for Instruction Bulletins that discuss digital printing methods.

An image is printed on electrostatic paper and transferred with heat and pressure to the film. Graphic protection is required.

Cutting

The following are common cutting methods for this film. See Instruction Bulletin 4.1 for details.

- Cold and hot steel-ruled die cutting
- Hot kiss cutting
- Drum-type electronic cutting
- Flat-bed electronic cutting
- Guillotine
- Hand cut

Design Considerations

- Use a minimum letter height of 1 inch (2.5 cm).
- Use a minimum stroke width of 3/8 inch (1.0 cm).
- Use a minimum radius for a point of 1/16 inch (1.6 mm).
- For uniform color and brightness when making a graphic with multiple pieces of the film together, be sure the pieces are properly color matched. See Instruction Bulletin 2.1 for details. Color-matched film is available by special order. Contact your 3M sales representative.
- Order "roll applicator splices" for roll striping. Butt splices may have a small gap.

Weeding Considerations

- For the best results, weed the film within 24 hours of cutting it.
- Perform weeding carefully. Removing the film from the liner reduces or may eliminate the slideability feature. For this same reason, do not attempt to exchange the liner.
- Refer to Instruction Bulletin 4.1 for more details.

Application Tapes

When to Use Premasking Tape

- As an application aid to increase stiffness, and prevent stretching and damage during application.
- Graphics larger than 4 square feet (0.4 m²).
- Striping greater than 4 inches (10 cm) wide.

When NOT to Use Premasking Tape

- Continuous rolls or striping wider than 12 inches (31 cm).
- Rolls wider than 12 inches (31 cm) that will be slit.

When to Use Prespacing Tape

- Hold cut and weeded letters or graphics in registration after removing the film liner.
- Protect cut graphic parts from scratching or damage during application.
- Use when large amounts of liner are exposed.

How to Select a Tape

Determine whether you want to premask the graphic or prespace cut graphics. Then select the application tape that corresponds to the graphic protection used. See Instruction Bulletin 4.3 for complete details.

Tape	No Printing	1920DR 4430R	9720i 9720UV 9800CL	8519	8912	8920
NR = not recommended						
Premasking SCPM-3	■	■		■	■	
Prespacing SCPS-2	■	■				■
Premasking SCPM-44X			■		NR	■



CAUTION

Before using any equipment, always read the manufacturer's instructions.

Application and Installation

Install the film using the dry application method.

Refer to the 3M Related Literature section, located at the end of this bulletin, for a list of the Instruction Bulletins that may be needed to apply or install this film.

Adhesive

This film has a pressure-activated adhesive that allows the film to slide easily on the substrate. Any pressure applied by hand, squeegee or application tool immediately bonds the film to the substrate and the slideability feature is lost. The film cannot be lifted and repositioned without damage.

Substrate Considerations

This film can be applied over other recommended 3M graphic systems. Graphics printed with clear 1920DR must be weathered for at least one year before applying this film over it. See Instruction Bulletin 5.1 for details.

Finishing

- If needed or recommended, use edge sealer 3950.
- Most graphics made with these films do not require an edge sealer, although certain applications may benefit from its use.
- All processed and unprocessed graphics subjected to fuel vapors or occasional fuel spills do require edge sealer.
- Edge sealing in the following applications is not required, but it may help keep the edges adhered when subjected to external sources such as abrasion and/or high pressure washing.
 - graphics exposed to severe abrasion or high pressure washing
 - graphics applied to chrome substrates
 - graphics applied to locomotives and rolling railroad stock
 - graphics applied to truck rollup doors

Maintenance and Cleaning

Use a cleaner designed for high-quality painted surfaces. The cleaner must be wet, non-abrasive, without strong solvents, and have a pH value between 3 and 11 (neither strongly acidic nor strongly alkaline.)

Refer to Instruction Bulletin 6.5 for details on pressure cleaning. Exceeding 3M's recommendations will void the warranty whether or not an edge sealer was properly used.

Removal

This film is not removable.

Shelf Life, Storage and Shipping

Shelf Life

Total shelf life: 2 years

Up to 2 years unprocessed, *OR* process within 1 year *and* apply within 1 year of processing

Storage Conditions

for Unprocessed Film or
Unapplied Finished Graphics

- 40° to 100°F (4° to 38°C)
- Out of sunlight
- Clean dry area
- Original container
- Cut sheets must lie flat
- Bring the film to print room temperature before using

Shipping Finished Graphics

Flat, or rolled printed side out on 6 inch (15 cm) or larger core. This helps prevent the application tape, if used, from popping off.

See Instruction Bulletin 6.5 for details.

Health and Safety



CAUTION

When handling any chemical products, read the manufacturers' container labels and the Material Safety Data Sheets (MSDS) for important health, safety and environmental information. To obtain MSDS sheets for 3M products go to 3M.com/MSDS, or by mail or in case of an emergency, call 1-800-364-3577 or 1-651-737-6501.

When using any equipment, always follow the manufacturers' instructions for safe operation.

Standards

ASTM D-4956-07: Standard Specification for Retroreflective Sheeting for Traffic Control

This information is important for applications that are regulated by ASTM or NFPA standards, for example, traffic control signs, emergency vehicles and certain railroad graphics. The user is solely responsible for determining and complying with all current and applicable local, state and federal regulations regarding the use and application of graphics materials

ASTM D-4956-07 covers flexible, non-exposed glass bead lens and microprismatic retroreflective sheeting designed for use on traffic control signs, delineators, barricades and other devices. For Type 1 sheeting it specifically covers these colors: white, yellow, orange, green, red, blue and brown. As defined in ASTM D-4956-07, film series 680 are classified as Type I sheeting (section 4.2.1) with a Class 3 adhesive (section 4.3.3). For corresponding colors covered by ASTM D-4956-07, the aforementioned films (except orange) meet the requirements specified in section 6.1.1 (minimum performance requirements for Type I sheeting).

NFPA® 1901: Standard for Automotive Fire Apparatus (2009 Edition)

According to NFPA® 1901, section 15.9.3.3 specifies that all retroreflective materials required by section 15.9.3.1 and 15.9.3.2 shall conform to the requirements of ASTM D 4956, *Standard Specification for Retroreflective Sheeting for Traffic Control*, Section 6.1.1 for Type I sheeting. Section 15.9.3.3.1 specifies that colors not listed in ASTM D-4956 can be used on the front and sides of the fire apparatus as long as the sheeting has a minimum coefficient of retroreflection of 10 when measured with an observation angle of 0.2° and an entrance angle of -4°.

	Red	Ruby Red	Yellow	Lemon Yellow	White	Blue	Light Blue	Green	Gold	Black
Color Number	72	82	71	81	10	75	76	77	64	85
Section 15.9.3.1 (Front & Sides)	●	●	●	●	●	●	●	●	●	●
Section 15.9.3.2 (Chevrons)	●	●	●	●						

3M Related Literature

Before starting any job, be sure you have the most current Product and Instruction Bulletins.

The information in 3M Product and Instruction Bulletins is subject to change. Current Bulletins are available at 3Mgraphics.com. The following applicable Bulletins provide information and processes you need to properly make the graphics described in this Bulletin. Additional Bulletins may be needed as indicated in the 3M Related Literature section of other 3M components you use.

Bulletin types: PB = Product Bulletin; PB-IB = Product & Instruction Bulletin; IB = Instruction Bulletin

	Subject	Type	Bulletin No.
Inks	3M™ Piezo Inkjet Ink Series 1500v2	PB-IB	1500
	3M™ Piezo Inkjet Ink Series 4400	PB-IB	4400
	3M™ Piezo Inkjet Ink Series 4600	PB-IB	4600
	3M™ Piezo Inkjet Ink Series 4800	PB-IB	4800
	3M™ Piezo Inkjet Ink Series 6800	PB-IB	6800

	Subject	Type	Bulletin No.
	3M™ Piezo Inkjet Ink Series 2200UV	PB-IB	2200UV
	3M™ Piezo Inkjet Ink Series 2600UVv2	PB-IB	2600UVv2
	3M™ Piezo Inkjet Ink Series 2700UV	PB-IB	2700UV
	3M™ Piezo Inkjet Ink Series 2800UV	PB-IB	2800UV
	3M™ Piezo Inkjet Ink Series 5400UV	PB-IB	5400UV
	3M Graphic Protection Products	PB	GP-1
	3M™ Screen Print UV Gloss Clear 9720i	PB-IB	9720i
Screen Printing	3M™ Screen Print Gloss Clear 9720UV -Applying screen printing clear 9720UV	PB IB	9700 3.4
	3M™ Screen Printing Ink Series 1900 and Clear 1920DR - Screen printing with ink series 1900- line color	PB IB	1900 3.12
	3M™ Scotchlite™ Screen Printing Ink Series 2900 - Screen printing with ink series 2900 - line color - 4-color	PB IB IB	2900 3.18 3.19
	3M™ Screen Printing UV Ink Series 9800 - Screen printing with UV ink series 9800 - line color - 4-color	PB IB IB	9800 3.20 3.21
Electrostatic Printing	3M™ Trident Transfer Paper	PB	Trident
	Transferring and laminating electrostatically printed images	IB	4.7
General Instructions	3M™ Screen Print Clear 8920 ES - Screen printing with clear 8920 ES	PB IB	8920 3.15
	Cold roll lamination	IB	4.22
	Design of graphics	IB	2.1
	Scoring and cutting	IB	4.1
	Using 3M application tapes; premasking and prespacing for films	IB	4.3
	Application, substrate selection, preparation, substrate-specific techniques	IB	5.1
	Application, special applications and vehicles	IB	5.4
	Application, general procedures for indoor and outdoor dry applications	IB	5.5
	Applicator's quick reference guide for vehicle film	IB	5.35
	Application: special considerations for complex contours of automobiles, vans and buses and inspection forms	IB	5.36
	Storage, handling, maintenance, removal	IB	6.5
	Warranty	3M Graphics Center Warranty Brochure	go to www.3Mgraphics.com , Warranties

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NFPA is a registered trademark of National Fire Protection Association, Inc; Tedlar is a registered trademark of DuPont Company.*

Bulletin Change Summary

Take note of the updated adhesion values on page 3. A clarification about warranted durability vs. expected durability for unprinted film was added. A limitation for film 680-14 (orange) has been added to the ASTM standard description on page 8.



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