



Sheeting, Scoring and Cutting of Film

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Description

This bulletin describes the proper techniques for sheeting, scoring and cutting graphic films. These instructions can be used with the following films. However, cutting information provided in the Product Bulletins for any specific film supersedes the instructions in this bulletin.

- 3M™ Scotchlite™ Reflective Graphic Film
- 3M™ Scotchlite™ Engineer Grade™ Reflective Sheeting
- 3M™ Scotchlite™ Diamond Grade™ Reflective Sheeting
- 3M™ Scotchlite™ High Intensity™ Reflective Sheeting
- 3M™ Scotchcal™ Graphic Films
- 3M™ Controltac™ Plus Graphic Films with Comply™ Performance
- 3M™ Controltac™ Plus Graphic Films

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:

- By fax, call 1-800-364-0768 in the US and Canada or 1-650-556-8417 for all other locations.
- Electronically, visit us at www.3M.com/MSDS.
- 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.

Note: For the full product names of the 3M products listed on this page, please see page 1.

Sheeting of Film and Reflective Sheeting

Note: This section is an update of sheeting information in Instruction Bulletin 2.1.

Color Matching

Color can vary in some types of films from lot to lot, within a roll from side-to-side or at a splice. Be sure to match the pieces whenever two or more pieces are used together in a single graphic.

Nighttime Retroreflective Color and Brightness

Brightness can vary slightly with Scotchlite reflective graphic films and sheeting. When producing large multi-panel jobs, order all of the film from the same lot and, if offered, order color-matched films.

To evaluate the color and brightness:

1. Mount the film at least 50 feet (15 m) from the observer.
2. Shine a spotlight toward the film at an angle a little less than perpendicular.

A 100 watt bulb with an 8 to 12 inch (20 to 30 cm) circular matte reflector closely approximates actual driving conditions. The light should be bright enough to reflect from the film, but not bright enough to illuminate the film.

3. Compare the film for brightness and color to ensure a uniform nighttime reflective appearance.
4. Identify the sheets so that they will not be mixed during fabrication or application.
5. Use the same technique for minimizing daytime color variation to minimize the nighttime color or brightness variation.

Daytime Color

Scotchlite Reflective Graphic Films and Sheeting, and Scotchcal Translucent Graphic Film

To overcome side-to-side variability on a roll, position the cut panels so that where they meet is from the same side of the roll. Notice that the matching edges are always swung to meet each other. For example, the right side of panel 1 and the left side of panel 2 should come from the right side of the roll. See Figure 1.

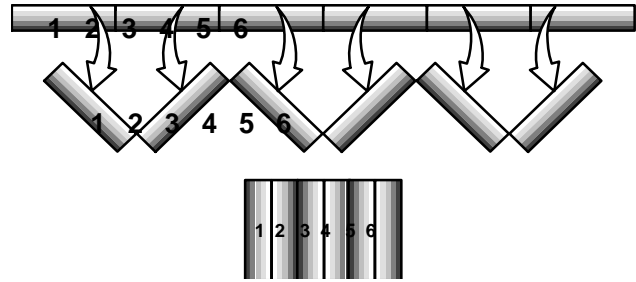


Figure 1. Color Matching Sheets

Fluorescent Film

Use only material from a single roll or run per graphic, particularly where panels meet. This ensures a uniform appearance for the performance life of the graphic.

Metallic Film

Fabricate the graphic so that the logos on the liner are consistently in the same direction. Metallic films have flakes that orient themselves during manufacture, which may make the film appear lighter or darker in color depending on the viewing angle.

Scoring

Film liners generally do not require scoring. If scoring is desired, print the graphic and then use a mechanical device to score the liner.

To minimize having the liner pop off of Engineer Grade reflective sheeting when scoring:

- Do not score the liner of die cut letters.
- Score at least 1 inch (2.5 cm) from the film edge. If scoring must be closer than 1 inch (2.5 cm), test the processing procedures and use conditions to determine if the results are satisfactory.
- Request pre-scored film to have at a minimum of 3 inches (8 cm) between cuts.

General Cutting Guidelines

- Keep all cutting tools sharp and clean to minimize the possibility of adhesive transfer or damage to the graphic. Reflective films and sheetings are abrasive and reduce the sharpness of the cutting tool at a faster rate than other films.
- Round the inside corners of letters and symbols using the largest radius that produces an acceptable appearance. This reduces the possibility of stress cracking and tearing.
- Cut the graphic with the face side up.
- Do not use mold release agents or oils on the cutting surface. They can contaminate the adhesive and prevent the graphic edge from adhering properly.
- Follow the Product Bulletins recommendations for letter height, stroke width, and point radius of the film to be cut. Cut letters or designs smaller than these recommendations cause difficulty in cutting and

weeding. Because of variations in equipment and font characteristics, users should determine their own cutting and weeding capabilities.

- Small or thin serifs and thin graphic lines are not suitable for fleet applications. The small surface contact of such serifs and lines to the substrate may not provide enough adhesion in typical fleet environments.

Warranty Issues

The recommendations in the following table are designed to eliminate problems in cutting and weeding, removing the application tape and film from the liner, and removing the application tape from the film after the letters have been applied to the graphic. Using smaller dimensions can be done on a customer test-and-approve basis, but the fabrication of such graphics will not be warranted by 3M. However, if the fabricator can successfully cut and apply graphics cut to smaller dimensions, the graphics will be warranted by 3M.

General Cutting Recommendations for Letters

Based on Helvetica medium upper and lower case copy. Always refer to the film's Product Bulletin for the most up to date cutting recommendations.

Type of Film	Liner/Adhesive Feature	Letter Height		Stroke Width		Radius ¹	
		inch	(mm)	inch(mm)		inch(mm)	
2 mil vinyl film	Synthetic, heavy weight	0.25	(0.63)	0.04	(1.00)	0.024	(0.60)
	Paper	0.375	(0.95)	0.04	(1.00)	0.024	(0.60)
	Polycoated	0.5	(12.50)	0.05	(12.50)	0.024	(0.60)
	Polycoated / Controltac	3.0	(76.20)	0.25	(6.35)	0.125	(3.18)
	Polycoated / Comply	3.0	(76.20) <i>Flat bed dual edge blade</i> 6.0 (152.00) <i>Friction fed cutter</i>	0.25	(6.35)	0.125	(3.18)
Film with e-film technology	Paper	0.375	(0.95) <i>Electronic or cold cut only</i>	0.04	(1.00)	0.024	(0.60)
4 mil vinyl film	Polycoated	0.5	(12.50)	0.09	(2.38)	0.050	(1.25)
	Polycoated / Controltac	3.0	(51.00)	0.25	(6.35)	0.125	(3.18)
	Polycoated / Comply	3.0	(51.00)	0.25	(6.35)	0.125	(3.18)
Scotchlite film	Paper	2.0	(5.10)	0.38	(10.00)	0.063	(1.60)
	Polycoated	3.0	(76.20)	0.38	(10.00)	0.063	(1.60)
	Polycoated / Controltac	3.0	(76.20)	0.38	(10.00)	0.063	(1.60)
	Polycoated / Comply	3.0	(76.20)	0.38	(10.00)	0.063	(1.60)
Scotchlite diamond grade, engineer grade, high intensity reflective sheeting	Paper	3.0	(76.20)	0.50	(12.70)	0.125	(3.18)
	Synthetic, lightweight	Not recommended for letters or symbols					
Luminous film	Paper	1.0	(25.00)	0.19	(4.8)	0.094	(2.38)

¹ This dimension refers to the inside corners of letters and symbols.

Hand Cut

Single sheets can be hand cut with a paper cutter, scissors, or razor blade.

Band Saw

Use a band saw for general cutting of large sheets or specific shapes. Most commercial band saws have speeds suitable for cutting film.

Blade Selection

Use a “skip tooth” blade with few teeth per inch. The blade should have sufficient set so that it has good clearance and the teeth do not fill. Keep the blade sharp to prevent tearing.

Blades such as these work well.

- Width: 3/16 inch (4.7 mm)
- Pitch: 4
- Set: 0.00 or 0.042 inch (1 mm)
- Gauge: 0.025 inch (0.6 mm)

Cutting Unapplied Film

1. Construct an assembly device from a sheet of 1/4 inch (6 mm) plywood with guide boards attached to two sides.
2. Stack the film on the assembly device, placing the sheets tightly against guide boards set along the sides. See Figure 2.
3. For unprinted film, apply a pattern of the graphic to a piece of 1/8 inch (3 mm) wallboard and place it over the film. Drive nails through the stack of film and into the plywood to hold the film in place.

For printed graphics, stacked in register, transfer the register marks printed on the graphic to the bottom of the plywood. Drive a nail through the marks. Stack the film by pushing the nail through the register mark on the film. See Figure 3.

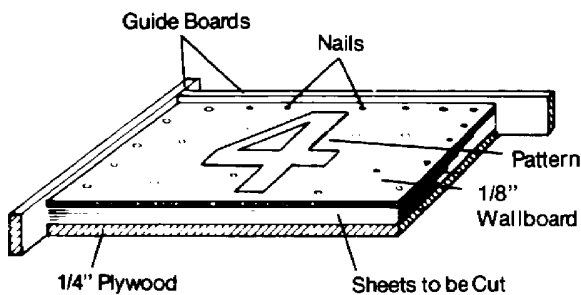


Figure 2. Stack Sheets and Set Guide Boards

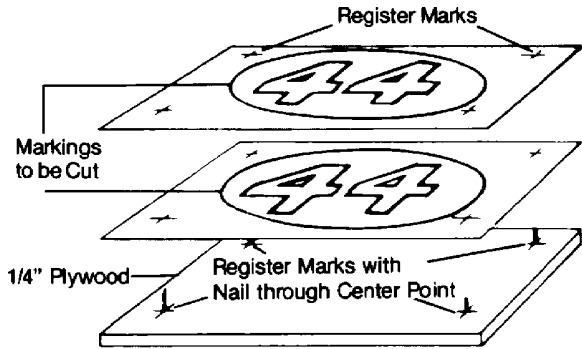


Figure 3. Securing Stacks with Nails

4. Remove the guide boards and saw as one piece.
5. Remove the wallboard and plywood from the top and bottom of the stack.
6. Remove the stack of cutouts and hold firmly, liner side up, in one hand.
7. Fan the edge of the stack, as you would a deck of cards, to separate the individual graphics.

Cutting Recommendations for Unapplied Film

- Do not use heavy pressure or the blade will overheat.
- Use the following guidelines for the maximum number of sheets in a stack.

Type of Film	Maximum Number of Sheets	Saw Speed feet/minute (m/minute)
Vinyl films	60 <i>unprinted</i> 35 <i>printed and/or premasked</i>	500 to 700 (152 to 213)
Films with e-film technology	60 <i>unprinted</i> 35 <i>printed and/or premasked</i>	500 to 700 (152 to 213)
Reflective films	25 <i>unprinted</i> 25 <i>printed</i>	1000 to 1500 (304 to 456)
Engineer Grade reflective sheeting	50 <i>unprinted</i> 50 <i>printed and/or premasked</i>	1000 to 1500 (304 to 456)
High Intensity reflective sheeting	50 <i>unprinted</i> 50 <i>printed</i>	1000 to 1500 (304 to 456)
Diamond Grade reflective sheeting	25 <i>unprinted</i> 25 <i>printed</i>	1000 to 1500 (304 to 456)

Cutting Film Applied to Aluminum Sign Blanks

- Operate the saw at 3500 feet per minute (1064 meters/minute).
- Use the following guidelines for the maximum number of sheets in a stack.

Number of Sheets	Aluminum Thickness
6	0.080 inch (2 mm) or thicker
10	0.080 inch (2 mm) or less

Guillotine Cutter

Use a guillotine-type cutter to cut a large volume of straight edges. The type and condition of cutter and blade, and the technique used determines the accuracy and quality of the cut. The following are suggestions for getting good results.

- Keep the cutting blades sharp. Blades used on an average of 8 hours or more per day should be re-sharpened every ten days.
- Use cardboard inserts as counters in the larger stacks. Include the thickness of the inserts as a part of the total stack height.
- Prevent cracking of certain films by using a double cut. Put the waste portion of the stack against the bevel edge of blade. See Figure 4.

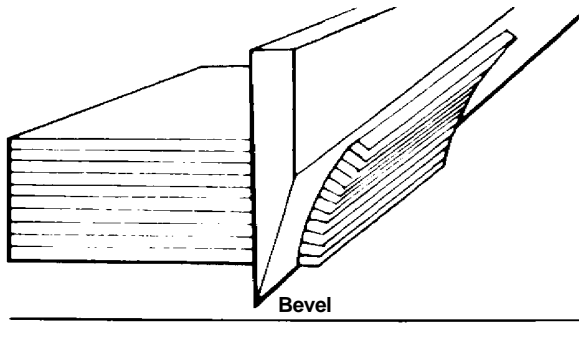


Figure 4. Cutting Stacks of Film

- Clean all adhesive buildup from the blade with a cloth soaked in mineral spirits, then dry the blade thoroughly. Always do this in a well-ventilated area.

- To minimize adhesive ooze on films with soft adhesives:
 - Do not double cut because ooze forms primarily on the flat side of the blade.
 - Keep the blade clean and sharp.
 - Cut in short stacks.
 - Keep the clamp-bar pressure at minimum. Stop cutting if the adhesive oozes. Adhesive ooze jogs the sheets. Remove adhesive from the edge of the sheets by placing the adhesive side of Scotch™ Masking Tape to the cut edge. Remove the tape and the adhesive ooze will adhere to it.

Cutting Recommendations for Guillotine Cutter

Type of Film	Recommendations
Vinyl films	4 inches (10.1 cm) Exception, film 3970 is 3 inches (7.6 cm)
Films with e-film technology	4 inches (10.1 cm)
Engineer Grade reflective sheeting	50 sheets Double Cut
Diamond Grade reflective sheeting	25 sheets Double Cut ¹

¹ Keep the clamp-bar pressure at a minimum to prevent crushing of the cells.

Electronic Cutting

Follow the recommendations in the film's Product Bulletin for minimum letter size and stroke width. (General cutting recommendations are on page 2 and 3 of this bulletin.) Letters or designs smaller than these recommendations may be difficult to cut or weed.

The proper cutting depth should result in the liner being *lightly* scored. Too deep a cut can cause a paper or polyethylene liner to split. In addition, too deep a cut increases knife wear and material lifting during cutting. Too light a cut can cause incomplete cutting of the film and adhesive, which can make weeding difficult.

Technically, all films can be electronically cut. However, the films specifically designed for electronic cutting include a special release agent between the liner and the adhesive that allows for optimum cutting and weeding.

Note: It is important to understand the difference between die cutting and kiss cutting.

- Die cutting cuts through both the film and liner.
- Kiss cutting cuts through only the film and adhesive, leaving the liner uncut.

Cold Die Cut

Steel Rule Dies

These dies are made from standard single or double bevel, steel rule that is 1 inch (2.5 cm) high and 1/32 inch (0.8 mm) thick. They are hand bent and mounted in 3/4 inch (1.8 cm) plywood or hardboard. See Figure 5. The straight edge of the single-bevel rule goes against the finished cut of the graphic. Small pieces of sponge, rubber or cork attached to the board on each side of the steel rule prevents the film from sticking to the rule.

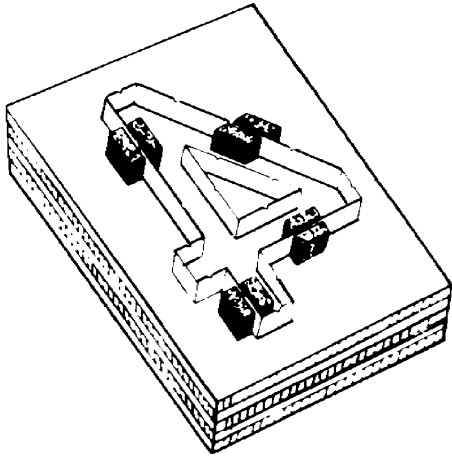


Figure 5. Using Steel Rule Dies

Cutting Recommendations for Cold Die Cutting

Type of Film	Steel Rule
Vinyl films	Yes
Films with e-film technology	Yes
Urethane films	No
Reflective films	Yes
Engineer Grade reflective sheeting	Yes
High Intensity reflective sheeting	No ¹
Diamond Grade reflective sheeting	No ¹

¹ Use heat to die cut to insure a quality cut and prevent the possibility of edge cracking.

Cutting Recommendations for Cold Kiss Cutting

Type of Film	Steel Rule
Vinyl films	Test and approve
Films made with e-film technology	Test and approve
Urethane films	No
Reflective films	Test and approve
Engineer Grade reflective sheeting	NR
High Intensity reflective sheeting	NA
Diamond Grade reflective sheeting	NR

Hot-Die Cut and Thermal Kiss Cut

Steel Rule Dies

Steel-rule dies are made from single bevel or double bevel, steel rule that is 3/8 inch (9 mm) high and 1/32 inch (0.8 mm) thick and mounted in 1/4 inch (6 mm) hardboard or tempered aluminum. This is not a standard construction and must be requested from the manufacturer. The material mounted on each side of the die used to prevent the film from sticking to the rule must be made of cork or other heat-resistant material.

Etched Dies

Etched dies are made by photoengravers and/or die makers from zinc, magnesium or copper. They are primarily used on graphics where it is very difficult to bend steel rule or the job size does not warrant the extra cost of steel rule dies.

The die plates are 1/4 inch (6 mm) thick. Standard techniques etch the plate to a depth of approximately 1/32 inch (0.8 mm). The life of a zinc die can be extended appreciably by chrome plating.

Use a 1/16 to 1/8 inch (1.59 to 3.2 mm) rubber or similar material on the bed, rather than the normal steel cutting platen. The material prevents damage to the die during make-ready.

Cutting Recommendations for Hot-Die Cut and Thermal Kiss Cut

- Follow the recommendations in the film Product Bulletin for minimum letter size, stroke width, and radius point. Letters or designs smaller than these recommendations may be difficult to cut or weed. The quality of the cut will also affect the durability of the graphic.

Continued on the next page.

- Use of excessive heat and/or pressure causes a ridge to form at the cut. Ridges can cause several problems.
 - The adhesive edge may be damaged or during application the ridge may prevent the adhesive from making good contact. Both can cause the film to edge lift.
 - The application tape may not have a good bond to the graphic making part pick-up difficult.
- The film can become imbedded in the liner also making part pick-up difficult.
- Do not cut films with a heat-activated adhesive.
- Purchase dies with a release coating to reduce sticking of the graphic and to obtain a cleaner cut.
- Use a steel-rule die if the film has an application tape.

Film Type	Steel Rule	Etched
Vinyl films	275° to 350°F (135° to 177°C)	275° to 350°F (135° to 177°C)
Films with e-film technology ¹	260° to 290°F (126° to 143°C) with less than 0.5 second dwell and a release coated die	260° to 290°F (126° to 143°C) with less than 0.5 second dwell and a release coated die
Urethane films	No	No
Reflective films	325° to 375°F (163° to 185°C)	325° to 375°F (163° to 185°C)
Engineer Grade reflective sheeting	350° to 400°F (177° to 204°C) series 6060 - NR	350° to 400°F (177° to 204°C) series 6060 - NR
High Intensity reflective sheeting	Yes ³	No
Diamond Grade reflective sheeting	Yes ³	No

¹ Vinyl films with plastic liners may have a more narrow temperature range. The best cutting, weeding and part pick-up performance will occur when the graphics are cut between 280° and 325°F. Use an adhesive-backed foam to keep the film from contacting the die face.

² Check the Product Bulletin to determine whether a film made with e-film technology can be cut. Some of these films have a low-melt temperature and are difficult to cut.

³ Order film with a paper liner

Weeding

- Inspect each element to determine that the film is cut completely before starting.
- Weed films with soft, aggressive adhesives as quickly after cutting as possible. These adhesives will flow and “heal over” the cut.
- Start weeding from the side where the graphic elements have most open cuts. See Figure 6.

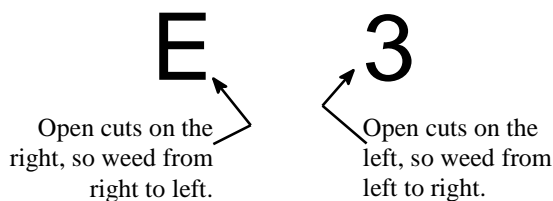


Figure 6. Determine Where to Start Weeding

- Use extra care when weeding films that have Comply performance. It is nearly impossible to re-adhere the film to the liner if it is mistakenly pulled off.

Warranty and Limited Remedy

The information contained and techniques described herein are believed to be reliable, but 3M makes no warranties, express or implied, including but not limited to any implied warranty of merchantability or fitness for a particular purpose. 3M shall not be liable for any loss or damages, whether direct, indirect, special, incidental or consequential, in any way related to the techniques or information described herein.

3M Related Literature

Listed below is related 3M technical literature that may be of interest. You may view and print these Bulletins from our Web site at www.scotchprint.com, or order them via our Fax-on-Demand (FOD) system. Call one of these phone numbers to order the desired bulletins, and specify the FOD document number provided in the chart.

United States or Canada: 1-800-364-0768

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Subject	Bulletin No.	FOD No.
Product Bulletins		
Films Order an index from the Fax-on-Demand system to identify the FOD No. for the film bulletins you need.		
Instruction Bulletins		
Using 3M application tapes; premasking and prespacing for films	4.3	6503
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Health & Safety

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