

Sheeting, Scoring and Film Cutting

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2. Description

This Bulletin describes the proper techniques for sheeting, scoring and cutting 3M graphic films. However, the cutting information provided for any given film's current Product Bulletin supersedes the instructions in this Bulletin.

3. Health and Safety



CAUTION

When handling any chemical products, read the manufacturers' container labels and the Safety Data Sheets (SDS) for important health, safety and environmental information. To obtain SDS 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.

A. Ventilation

Provide local and/or general exhaust ventilation wherever heat is used in film cutting or chemicals are used to clean blades to prevent a buildup of vapors and to maintain levels below the limit for worker exposure. An experienced industrial ventilation engineer and/or a certified industrial hygienist can help evaluate your ventilation requirements and design based on your site process conditions.

4. Sheeting

A. 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.

B. Nighttime Retroreflective Color and Brightness

Brightness can vary slightly with 3M™ 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.

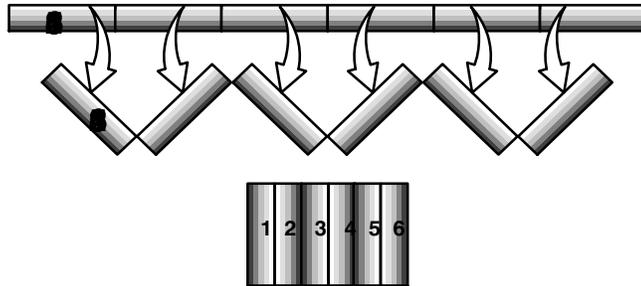
To evaluate the color and brightness:

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.

C. Reflective Films and Translucent Films

To overcome side-to-side variability on a roll, position the cut panels so that the panels meet 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



D. 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.

E. Metallic Film

Fabricate the graphic so that the logos on the liner read 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.

5. 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.

6. General Cutting Guidelines

- About recommended cutting sizes
 - This Bulletin provides detailed cutting information. However, for the most up to date information, we recommend that you review your film's Product Bulletin for letter height, stroke width, and point radius.
 - Cut letters or designs smaller than the recommended sizes may be difficult to cut and weed.
 - Small or thin serifs and thin graphic lines, which may not provide enough adhesion to the substrate, are not suitable for fleet applications.
 - Because of variations in equipment and font characteristics, users should determine their own cutting and weeding capabilities.
 - Cut the film or graphic with the face side up.
 - 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.
- Cutting tool maintenance
 - 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.
 - Do not use heavy pressure or the blade will overheat.
 - 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.

A. Warranty Limitations

The recommendations in the following table are designed to eliminate problems: (a) in cutting and weeding; (b) removing the application tape and film from the liner; and (c) removing the application tape from the film after the letters have been applied to the substrate. Smaller dimensions may be used only on a customer test-and-approve basis, with the understanding that such graphics will not be warranted by 3M. For more information on application tapes, see [3M Instruction Bulletin 4.3](#).

B. Letters and Symbols

These values are based on Helvetica medium font for upper and lower case copy.

TABLE 1
Recommended
Minimum Cutting
Sizes for Letters
and Symbols

Type of Film	Liner Feature	Adhesive Feature	Letter Height inch (mm)	Stroke Width inch (mm)	Radius ¹ inch (mm)
2 mil vinyl film	Synthetic, heavy weight	-	0.25 (6.35)	0.04 (1.02)	0.024 (0.61)
	Paper	-	0.375 (9.52)	0.04 (1.02)	0.024 (0.61)
	Polycoated	-	0.5 (12.7)	0.05 (1.27)	0.024 (0.61)
	Polycoated	Repositionable	3.0 (76.20)	0.25 (6.35)	0.125 (3.18)
	Polycoated	Air release channels	3.0 (76.20) <i>Flat bed dual edge blade</i> 6.0 (152.40) <i>Friction fed cutter</i>	0.25 (6.35)	0.125 (3.18)
4 mil vinyl film	Polycoated	-	0.5 (12.7)	0.09 (2.29)	0.050 (1.27)
	Polycoated	Repositionable	3.0 (76.20)	0.25 (6.35)	0.125 (3.18)
	Polycoated	Air release channels	3.0 (76.20)	0.25 (6.35)	0.125 (3.18)
	Paper	-	0.5 (12.7)	0.25 (6.35)	0.125 (3.18)
Vinyl film with sidewalk or floor overlamine	Polycoated	-	Not recommended for letters or symbols		
Non-PVC	Polycoated	Air release channels	3.0 (76.20)	0.38 (9.52)	0.063 (1.60)
Polyolefin film	Polycoated	Repositionable	Not recommended for letters or symbols		

Table 1 continued on the next page

TABLE 1
Continued
Recommended
Minimum Cutting
Parameters

Type of Film	Liner	Adhesive Feature	Letter Height inch (mm)	Stroke Width inch (mm)	Radius ¹ inch (mm)
Enclosed lens retroreflective film	Polycoated	-	3.0 (76.20)	0.38 (9.52)	0.063 (1.60)
3M™ Scotchlite™ Reflective Graphic Films 5000, IJ5000					
Enclosed lens retroreflective film	Polycoated	-	1.0 (25.40)	0.38 (9.52)	0.063 (1.60)
3M™ Scotchlite™ Reflective Graphic Films 5100, 5100R, IJ5100, IJ5100R					
Enclosed lens retroreflective film	Polycoated	Slideable	1.0 (25.40)	0.38 (9.52)	0.063 (1.60)
3M™ Scotchlite™ Reflective Graphic Films 680, IJ680					
Enclosed lens retroreflective film	Polycoated	Air release channels	1.0 (25.40)	0.38 (9.52)	0.063 (1.60)
3M™ Scotchlite™ Reflective Graphic Films 680CR, IJ680CR					
Prismatic reflective sheeting	Paper	-	3.0 (76.20)	0.50 (12.7)	0.125 (3.18)
	Synthetic, lightweight	-	Not recommended for letters or symbols		

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

C. Hand Cut

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

D. 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.

(1) 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)

(2) 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, page 5.
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, page 5.

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.

FIGURE 2
Stack Sheets and Set Guide Boards

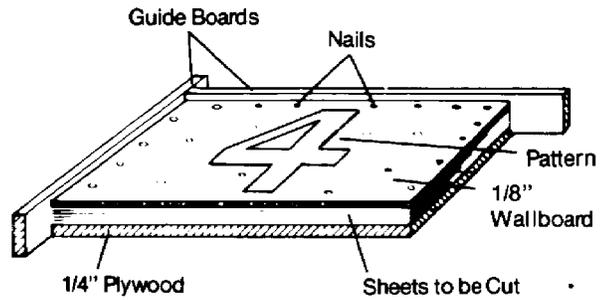
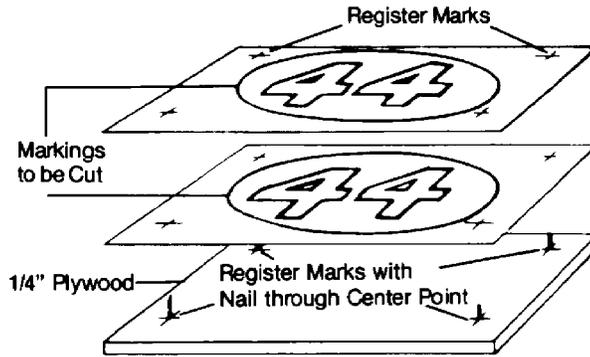


FIGURE 3
Securing Stacks with Nails



E. Cutting Unapplied Film

Use the guidelines in Table 2 for Film sheet stacks, and the Guidelines in Table 3 for Film applied to aluminum sheets.

TABLE 2
Maximum Film Sheet Stacks
and Saw Speed

Type of Film	Maximum Number of Sheets	Saw Speed <i>feet/minute (m/minute)</i>
Vinyl films	60	500 to 700 (152 to 213)
	35	
Non-PVC films	60	500 to 700 (152 to 213)
	35	
Polyolefin films	60	500 to 700 (152 to 213)
	35	
Enclosed lens reflective films	25	1000 to 1500 (304 to 456)
	25	
Prismatic reflective sheeting	50	1000 to 1500 (304 to 456)
	50	

TABLE 3
Maximum Aluminum with Film Sheet
Stacks and Saw Speed

Number of Sheets	Aluminum Thickness inch (mm)	Saw Speed <i>feet/minute (m/minute)</i>
6	0.080 (2) or thicker	3500 (1064)
10	0.080 (2) or less	3500 (1064)

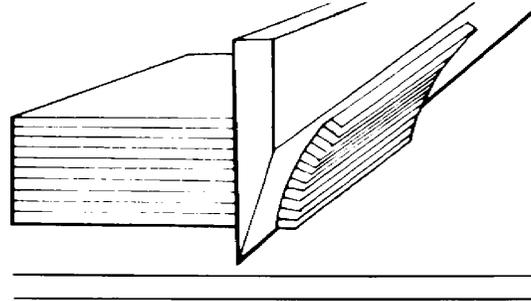
F. Guillotine Cutter

(1) General Information

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



(2) Keep Blades Clean

- 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 to avoid joggling the sheets. To remove oozed adhesive, apply a piece of Scotch™ Masking Tape to the cut edge, and then pull off the tape to pull off the ooze.

TABLE 4
Cutting Recommendations for
Guillotine Cutter

Type of Film	Recommendations
Vinyl films	4 inches (10.1 cm)
Non-PVC films	4 inches (10.1 cm)
Polyolefin films	4 inches (10.1 cm)
Enclosed lens reflective sheeting	50 sheets, Double Cut
Prismatic reflective sheeting	25 sheets, Double Cut ¹

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

G. Electronic Cutting

The proper cutting depth should result in the liner being *lightly* scored. Too deep a cut can cause a paper or polycoated 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.

It is important to understand the differences 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.

H. Cold Die Cutting

(1) Steel Rule Dies

Steel rule 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. 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. See FIGURE 5.

FIGURE 5
Using Steel Rule Dies

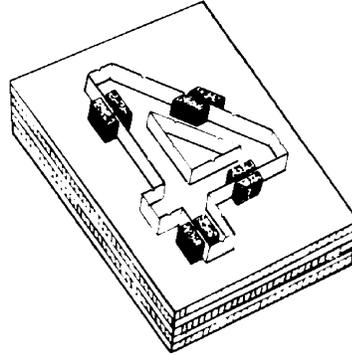


TABLE 5
Cutting Recommendations for
Cold DIE Cutting

Type of Film	Steel Rule
Vinyl films	Yes
Non-PVC films	Yes
Polyolefin films	Yes
Urethane films	Not recommended
Commercial reflective films	Yes
Enclosed lens reflective films	Yes
Prismatic reflective sheeting	Not recommended ¹

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

TABLE 6
Cutting Recommendations for
Cold KISS Cutting

Type of Film	Steel Rule
Vinyl films	Test and approve
Non-PVC films	Test and approve
Polyolefin films	Test and approve
Urethane films	Not recommended
Commercial reflective films	Test and approve
Enclosed lens reflective films	Not recommended
Prismatic reflective sheeting	Not recommended

I. Hot-Die Cut and Thermal Kiss Cut

(1) 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 that prevents the film from sticking to the rule must be made of cork or other heat-resistant material.

(2) 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.
- Die plates are 1/4 inch (6 mm) thick. Standard techniques etch the plate to 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.

(3) Cutting Recommendations for Hot-Die and Thermal Kiss Cut

- Follow the recommendations in the film's 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.
- Excessive heat and/or pressure causes a ridge to form at the cut. Ridges can cause several problems, including:
 - 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 such as PTFE (polytetrafluoroethylene) to reduce sticking of the graphic and to obtain a cleaner cut.
- Use a steel rule die if the film has an application tape.

TABLE 7
Cutting Recommendations for Hot Die
and Thermal Kiss Cut

Film Type	Steel Rule	Etched
Vinyl films ¹	275°-350°F (135°-177°C)	275°-350°F (135°-177°C)
Non-PVC films ²	275°-350°F (135°-177°C) <i>Test and approve only</i>	275°-350°F (135°-177°C) <i>Test and approve only</i>
Polyolefin films ²	260°-290°F (126°-143°C) with less than 0.5 second dwell and a release coated die	260°-290°F (126°-143°C) with less than 0.5 second dwell and a release coated die
Urethane films	Not recommended	Not recommended
Commercial reflective films	325°-375°F (163°-185°C)	325°-375°F (163°-185°C)
Enclosed lens reflective sheeting	350°-400°F (177°-204°C)	350°-400°F (177°-204°C)

1. Vinyl and non-PVC films with plastic liners may have a more narrow temperature range. The best temperature for cutting, weeding and part pick-up performance is when graphics are between 280° and 325°F (137° and 162°C). Use an adhesive-backed foam to keep the film from contacting the die face.

2. Not all polyolefin films may be suitable for hot cutting. Check the film's Product Bulletin.

7. 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.
- Use extra care when weeding films that have Comply adhesive. It is nearly impossible to re-adhere the film to the liner if it is mistakenly pulled off.

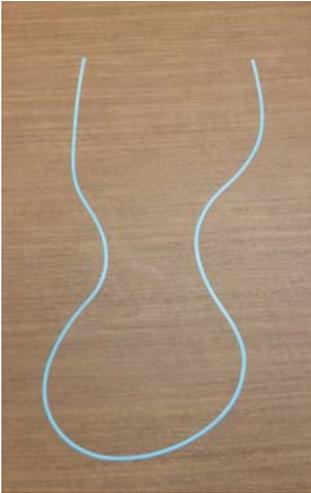
FIGURE 6
Determine Where to Start Weeding



8. Using Knifeless™ Tape

Knifeless Tape from Knifeless Technology Systems is a narrow, very flexible, adhesive-backed film product embedded with a high strength filament that can cut film precisely and cleanly.

- 3M recommends using this tape with most 3M cast films for vehicles, windows and walls without removing accessories, and without risk of damaging the substrate or film with a blade cutter.
- Always text and approve this method before using it on a customer's order.
- For more information and ideas on how to use this product, and for ordering, contact knifelesstechsystems.com. The film shown in these photographs is 3M™ Wrap Film 1080-CF12 Carbon Fiber Black.



1. Apply Knifeless Tape along the edge where you want to trim the film, extending it slightly past the edge. To change the line, simply reposition the tape.



2. Install the film in panels in the normal manner.



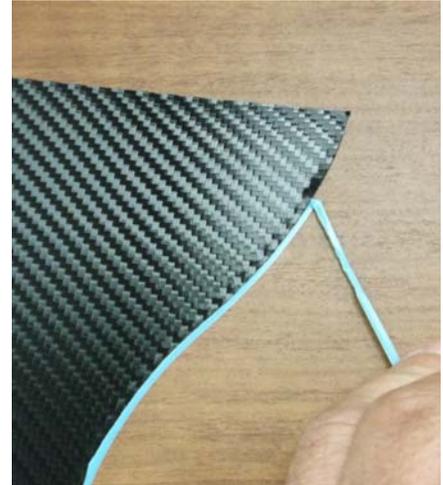
3. To cut the film, grasp just the filament and pull it back through the tape and the film.



4. Remove the excess film.



5. Notice the clean sharp cuts.



6. Tuck the trimmed film in around the edges, as needed and squeegee the edges.

9. Disclaimer

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.

The [3M Graphics Warranties Brochure](#), along with the applicable film Product Bulletins, provide the details to any warranty offered for the 3M graphics products described in this Bulletin.

10. Limitation of Liability

Except where prohibited by law, 3M SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE TO PURCHASER OR USER FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, LABOR, NON-3M MATERIAL CHARGES, LOSS OF PROFITS, REVENUE, BUSINESS, OPPORTUNITY, OR GOODWILL) RESULTING FROM OR IN ANY WAY RELATED TO SELLER'S PRODUCTS, SERVICES OR THIS BULLETIN. This limitation of liability applies regardless of the legal or equitable theory under which such losses or damages are sought including breach of contract, breach of warranty, negligence, strict liability, or any other legal or equitable theory.

11. Bulletin Change Summary

New or revised information is marked by a black bar in the margin. Updated the name of 3M™ Wrap Film Series 1080. The 3M Related Literature section has been replaced by direct links to the most current versions of Bulletins or warranty information you may need to successfully use this product. All links are blue underlined text.



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