For all Imaging Methods

How to Use This Bulletin
1. Determine the type of backlit graphic you want to make.
2. Review the 3M Product Bulletins for the films you are using to determine any special usage details or restrictions, and whether an overlaminate is required.
3. Refer to the 3M Product and Instruction Bulletins for the ink or toner you are using to determine processing conditions for backlit signs.
5. Read “General Assembly” on page 20.
6. Follow the assembly method for your specific construction.

General Information

IMPORTANT NOTE
There are many other options that may be available to achieve dramatic special effects that are not listed in this Bulletin. Please contact Technical Service (1-800-328-3908) before you start if you have questions or concerns about making a sign.

Characteristics of Light Boxes
Making a successful sign face requires that you consider many factors. This Bulletin provides basic guidelines for simple sign face construction. For information on making efficient sign boxes and cabinets see 3M Instruction Bulletin 2.4.

To minimize hot spots and washed out graphic appearance:
- Use a diffuser film between the light source and the image. There will be some loss in overall image brightness, but a more uniform image.
- To maximize the use of light inside a light box, line the box with 3M™ Light Enhancement Film 3635-100. This is highly efficient diffuse reflective film that creates a brighter, more uniform appearing sign face.
- 3M™ Blockout Films 3635-20b or 3635-22b can also be used to blockout transmitted light in some signs.
- See “Printing or Imaging Methods” on page 19.

Compatible Products
See 3Mgraphics.com for a complete list of compatible translucent materials suitable for creating backlit signage.

Warranty and Durability
For complete details on durability and warranty, please refer to the base film’s 3M Product Bulletin.

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/SDS, 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 manufacturer’s instructions for safe operation.
Air Quality Regulations

State Volatile Organic Compound (VOC) regulations may prohibit the use of certain cleaning chemicals with VOC’s in graphic arts coatings and printing operations. For example, the California South Coast Air Quality Management District prohibits use of certain solvent based solutions without a permit. Check with your State environmental authorities to determine whether use of particular chemistries may be restricted or prohibited.

Tools Needed

- 3M™ Plastic Applicator PA-1 (blue or gold)*
- 3M™ Low Friction Sleeve SA-1*
  (Use a low friction sleeve on the plastic applicator to minimize the possibility of scratching the film)
- Pin or 3M™ Air Release Tool 391X*
- Razor blades/cutting knives
- Straight edge
- Tape measure
- Pencil or pen
- Spray bottle or plastic garden sprayer
- Clean, soft, lint-free cloths or paper toweling
- Light table
- Adequate clean work area

*Available from 3M Graphics Solutions Division.

Common Sign Face Definitions

First or Second Surface?

Backlit signs are constructed with film applied on either the first or second surface of the substrate. The following illustrations show several first and second surface constructions and their assembly order.

The surface you choose depends on several factors. First surface graphics can use translucent or clear substrates. Second surface graphics require a clear substrate.

First Surface Application

First Surface - the outside of the sign face, the side of the sign face first seen when you look at the sign. The colored film or printed film is mounted on the outside surface of the clear sign face. The diffuser is mounted second surface.

Figure 1. First Surface Application
Second Surface Application
Second Surface - the inside of the sign face, the side of the sign face inside the sign box. The colored film or printed film is mounted on the inside surface of the clear sign face.

![Figure 2. Second Surface Application](image)

Overlaminate
Overlaminate - clear protective film applied on the top layer of films applied to the first surface of the sign face.

Translucent
Translucent - allowing light to pass through, but obscuring anything beneath or behind.

Transparent
Transparent - allowing light to pass through and allowing clear visibility of anything beneath or behind.

Substrate
Substrate - material films are applied to, generally rigid or flexible.

Diffuser
Diffuser - white translucent film layer used to hide the light source and improve uniformity of light across the sign face.

Purpose of a Diffuser
A diffuser reduces the amount of light transmission through the graphic and reduces the uneven or stripped effect caused by some types of light sources. Too little diffusion can also make the image look lighter (more washed out) than desired. Usually, sufficient diffusion may be achieved by using a translucent substrate, a translucent imaged film, and/or a translucent film specifically designed as a diffuser.

- **3M™ Diffuser Film 3635-30** has 42% light transmission.
- **3M™ Diffuser Film 3635-70** has 65% light transmission.
- **3M™ Envision™ Diffuser Films 3735-50** has 52% light transmission.
- **3M™ Envision™ Diffuser Films 3735-60** has 63% light transmission.

### IMPORTANT NOTE
Backlit signs made with 3M translucent films must have a separate diffuser film or be made with a diffused substrate such as **3M™ Panographics™ III Wide Width Flexible Substrate**, **3M™ Envision™ Flexible Substrate FS-1**, or White Translucent Plastic.

Construction Options
**NOTE:** The proportions of the following illustrations are intentionally exaggerated to provide more detail about the order of the materials used.

**NOTE:** For all of the following constructions, the adhesive side of the film faces the substrate.
Using Three Film Layers

**NOTE:** Some of the following options will show three layers of film applied to the first surface of a sign face.

For printed graphics, whenever three consecutive layers of film (two layers of printed film and an overlaminate) are used, the top layer of film must extend beyond the edges of the two underlying layers of film by at least one inch all around. The following illustrations show the proper construction when using three layers of film.

- Cut the underlying two layers smaller than the substrate so that the top (third layer) can be adhered to the substrate.

![Figure 3. Two film layers with overlaminate cut larger](image)

- Wrap at least a one inch margin of film around the substrate. This is a good method for First Surface graphics but not for second surface graphics.

![Figure 4. Overlaminate shown wrapped around construction](image)

**First Surface Sign Face Options**

For first surface graphics the film image is right reading when viewed from in front of the sign and the colored film or printed film is mounted on the first surface of the clear sign face. An overlaminate may be used to provide protection from abrasion and UV light, change the gloss and/or increase the graphic’s warranted durability.

**Option 1, Non-Printed, Color Translucent film, first surface, on a Clear Rigid Substrate**

<table>
<thead>
<tr>
<th>Ref. Letter</th>
<th>Component</th>
<th>Typical Compatible Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Overlaminate if required</td>
<td>3658G, 3660M, None</td>
</tr>
<tr>
<td>B</td>
<td>Colored Translucent Film first layer</td>
<td>3630, 3730, 3632GPS (no overlaminate)</td>
</tr>
<tr>
<td>C</td>
<td>Diffuser</td>
<td>3685-30, 3685-70, 3785-50, 3785-60</td>
</tr>
<tr>
<td></td>
<td>A diffuser is commonly used to eliminate hot spots. Make a test sign, check for hot spots.</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Substrate</td>
<td>Rigid Clear</td>
</tr>
</tbody>
</table>

1. Apply the overlaminate (A) to the Colored Translucent Film (B).
2. Apply the colored translucent film (B) to the front (first surface) of the Substrate (D).
3. Apply the Diffuser film (C) to the back (second surface) side of the Substrate (D).
Option 2, Digitally Printed Inkjet Film, first surface, on a Clear Rigid Substrate

<table>
<thead>
<tr>
<th>Ref. Letter</th>
<th>Component</th>
<th>Typical Compatible Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Overlaminate If required</td>
<td>3658G, 3660M, 8519, 8520, None</td>
</tr>
<tr>
<td>B</td>
<td>Imaging Film first layer</td>
<td>IJ3630-20, IJ3730-50, IJ3730-60, Digital Print White Translucent Film</td>
</tr>
<tr>
<td>C</td>
<td>Imaging Film second layer if required</td>
<td>IJ3650-114 (Clear)</td>
</tr>
<tr>
<td>D</td>
<td>Substrate</td>
<td>Rigid Clear</td>
</tr>
</tbody>
</table>

Note: This may be a three layer construction.
1. Apply the overlaminate (A) to the Imaging Film (B).
2. Apply the Imaging Film (B) to the front (first surface) of the Imaging Film (C).
3. Apply the Imaging film (C) to the back (second surface) side of the Substrate (D).

Option 3, Color Translucent film or printed inkjet film, first surface, on a White Translucent Rigid or Flexible Substrate

<table>
<thead>
<tr>
<th>Ref. Letter</th>
<th>Component</th>
<th>Typical Compatible Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Overlaminate If required</td>
<td>3658G, 3660M, 8519, 8520, None</td>
</tr>
<tr>
<td>B</td>
<td>Imaging Film or Colored Translucent Film first layer</td>
<td>IJ3630-20, IJ3730-50, IJ3730-60, or 3630, 3730, Color Translucent Film</td>
</tr>
<tr>
<td>C</td>
<td>Imaging Film second layer if required</td>
<td>IJ3650-114 (used with Imaging Film only)</td>
</tr>
<tr>
<td>D</td>
<td>Substrate</td>
<td>White Translucent or Flexible Substrate Layer</td>
</tr>
</tbody>
</table>

Note: This may be a three layer construction.
1. Apply the overlaminate (A) to the Layer (B).
2. Apply Layer (C) to the first surface of Layer (D).
3. Apply Layer (B) to the first surface of Layer (C).
Second Surface Sign Face Options

The graphic is printed as a mirror image and mounted on the second surface of the sign face. The clear, rigid substrate protects the graphic. Overlaminates are generally not used on second surface application.

Option 1, Colored Translucent film or Digitally printed film, Second Surface, on a Clear Rigid Substrate

<table>
<thead>
<tr>
<th>Ref. Letter</th>
<th>Component</th>
<th>Graphic Construction Inkjet</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Substrate</td>
<td>Rigid Clear</td>
</tr>
<tr>
<td>B</td>
<td>Imaging Film first layer</td>
<td>LJ3650-114 (Clear) or Translucent Colored Film</td>
</tr>
<tr>
<td>C</td>
<td>Imaging Film first or only layer</td>
<td>LJ3630-20, or LJ3730-50, or LJ3730-60 Digital Print White Translucent Film</td>
</tr>
<tr>
<td>D</td>
<td>Diffuser Film</td>
<td>Use with Translucent Colored Film. Not required with Imaging Film</td>
</tr>
</tbody>
</table>

1. Apply the Film (C) to the back (second surface) of the substrate (A).
2. For digitally printed film only, align and apply the second layer of Imaging Film (C) to the first layer of film (B).
3. A diffuser film (D) is applied to the Translucent Colored Film (C). Read “Using Three Film Layers” on page 4.
How to Construct Backlit Sign Faces

Direct Printing on Flexible Substrates

Direct Inkjet Printing on Flexible Substrates

<table>
<thead>
<tr>
<th>Ref. Letter</th>
<th>Component</th>
<th>Typical Compatible Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Panographics III or Envision FS-1 Substrates</td>
<td>See 3M Product Bulletin P3 or 3M Product Bulletin FS-1 for a full list of compatible printers/inks and overlaminates.</td>
</tr>
<tr>
<td>B</td>
<td>Overlaminate</td>
<td></td>
</tr>
</tbody>
</table>

1. Refer to the 3M Product and Instruction Bulletins for the ink you are using to determine processing conditions for backlit signs. Typically, do not exceed 300% total ink coverage.
2. A single layer of ink applied to the first surface of a flexible surface sign face generally appears pale or washed out when lit. To create a sign face that appears similar lit and unlit on flexible substrates:
   a. For printer/ink systems without white ink capability - print the same image, using the same level of ink laydown on both the first and second surface of the flexible substrate.
   b. For printer/ink systems with white ink capability - print three layers of ink, ink - white - ink, on the first surface of the flexible substrate.
How to Construct Backlit Sign Faces

Basic Techniques

Single Color Image on White Background

The majority of applications for a backlit sign are single color image on a white background, or a white image reversed out of a single color background. Both are simple letter cutting and film application technique that can be done either by hand or on an electronic film cutter.

First Surface Application

1. Cut, weed, and prespace image on Color Translucent Film (C).
2. Prepare White Translucent Substrate (B).
3. Apply Color Translucent Film (C) to the front of Substrate (B).
4. Apply Diffuser Film (A) to back of Substrate (B) if using clear Substrate.
5. Apply Graphic Protection Film (D) over Color Translucent Substrate (C) if you need maximum graphic protection.

Second Surface Application

1. Reverse cut, weed, and prespace image on Color Translucent Film (C).
2. Prepare clear Substrate (B).
3. Apply Color Translucent Film (C) to back of Substrate (B).
4. Apply Diffuser (A) to back of Color Translucent Film (C).

White Background: Day

White Background: Night

[Diagram of First Surface Application]

[Diagram of Second Surface Application]
# How to Construct Backlit Sign Faces

## White Image on Single Color Background

### Color Background: Day

- First Surface Application
  1. Cut, weed, and prespace image on Color Translucent Film (C).
  2. Prepare White Translucent Substrate (B).
  3. Apply Color Translucent Film (C) to the front of Substrate (B).
  4. Apply Diffuser Film (A) to back of Substrate (B) if using clear Substrate.
  5. Apply Graphic Protection Film (D) over Color Translucent Substrate (C) if you need maximum graphic protection.

### Color Background: Night

- Second Surface Application
  1. Reverse cut, weed, and prespace image on Color Translucent Film (C).
  2. Prepare clear Substrate (B).
  3. Apply Color Translucent Film (C) to back of Substrate (B).
  4. Apply Diffuser (A) to back of Color Translucent Film (C).

## Color Background:

- **Day**
- **Night**

<table>
<thead>
<tr>
<th>First Surface Application</th>
<th>Second Surface Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diffuser Film (A)</td>
<td>Clear Substrate (B)</td>
</tr>
<tr>
<td>(With Clear Substrate)</td>
<td></td>
</tr>
<tr>
<td>Substrate (B)</td>
<td></td>
</tr>
<tr>
<td>Translucent Film (C)</td>
<td>Translucent Film (C)</td>
</tr>
<tr>
<td>GPS Film (D)</td>
<td>Diffuser Film (A)</td>
</tr>
</tbody>
</table>

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How to Construct Backlit Sign Faces

Color Image on Color Background

A color background with color image is more complex, but you can still easily add it to your sign shop capabilities. Since the role of color is increased in this technique, important considerations for your customers include contrast, eye appeal, legibility and lay-out.

<table>
<thead>
<tr>
<th>First Surface Application</th>
<th>Second Surface Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diffuser Film (A)</td>
<td>Clear Substrate (B)</td>
</tr>
<tr>
<td>Substrate (B)</td>
<td>Translucent Film (D)</td>
</tr>
<tr>
<td>Translucent Film (C)</td>
<td>Translucent Film (C)</td>
</tr>
<tr>
<td>GPS Film (E)</td>
<td>Diffuser Film (A)</td>
</tr>
</tbody>
</table>

First Surface Assembly
1. Cut, weed, and prespace images on Color Translucent Film (D) and (C).
2. Prepare White Translucent Substrate (B).
3. Apply Color Translucent Film (D) to the front of Substrate (B).
4. Apply Color Translucent Film (C) to Film (D).
5. Apply Diffuser Film (A) to back of Substrate (B) if using clear Substrate.
6. Apply Graphic Protection Film over Color Translucent Substrate (D) if you need maximum graphic protection.

Second Surface Assembly
1. Reverse cut, weed, and prespace images on Color Translucent Film (D) and (C).
2. Prepare clear Substrate (B).
3. Apply Color Translucent Film (D) to back of Substrate (B).
4. Apply Color Translucent Film (C) to Film (D).
5. Apply Diffuser (A) to back of Color Translucent Film (D).
How to Construct Backlit Sign Faces

White Background by Day, Black Background by Night

With this technique, your customer will have a background that appears white by day and black by night. At night, the color image will appear to float, similar to the appearance created by push-through letters in a routed metal face. The color image will be the same color by day or night.

**First Surface Application**

1. Prepare Substrate (B) and apply Color Translucent Film (C) to front of Substrate.
2. Cut, weed, and prespace image on White Block-Out Film (D).
3. Apply White Block Out Film (D) over Translucent Film (C).
4. Apply Diffuser Film (A) to back of Substrate (B) if using clear Substrate.
5. Apply Graphic Protection Film (E) over Block-Out Film (D) if you need maximum graphic protection.

**Second Surface Application**

1. Reverse cut, weed, and prespace image in Black Block-Out Film (D).
2. Prepare clear Substrate (B) and apply Black Block-Out Film (D) to second surface of Substrate (B).
3. Apply Translucent Color Film (C) over Black Block Out Film (D).
4. Apply Diffuser (A) over Color Translucent Film (C).
How to Construct Backlit Sign Faces

Color Background by Day, Black Background by Night

With this special effect technique, your customer will have a background that appears in color by day and black by night. At night, the color image will appear to float, similar to the appearance created by push-through letters in a routed metal face. The color image will be the same color by day or night.

<table>
<thead>
<tr>
<th>Day</th>
<th>Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWT</td>
<td>SWT</td>
</tr>
<tr>
<td>SOUTH WEST TRUST</td>
<td>SOUTH WEST TRUST</td>
</tr>
</tbody>
</table>

First Surface Application
1. Prepare Substrate (B) and apply Color Translucent Film (C) to front of Substrate.
2. Cut, weed, and prespace image on White Block Out Film (D).
3. Apply White Block Out Film (D) over Translucent Film (C).
4. Cut, weed, and prespace image on Translucent Film (E).
5. Apply Color Translucent Film (E) over White Block Out Film (D).
6. Apply Diffuser Film (A) to back of Substrate (B) if using clear Substrate.
7. Apply Graphic Protection Film over Block Out Film (D) if you need maximum graphic protection.

Second Surface Application
1. Reverse cut, weed, and prespace image in Color Translucent Film (E).
2. Prepare clear Substrate (B) and apply Color Translucent Film (E) to back of Substrate.
3. Reverse cut, weed, and prespace image in Black Block Out Film (D).
4. Apply Black Block Out Film (D) over Color Translucent Film (E).
5. Apply Color Translucent Film (C) over Black Block Out Film (D).
6. Apply Diffuser (A) over Color Translucent Film (C).
How to Construct Backlit Sign Faces

Special Effects

White Halo Background with Color Image

With this special effect technique there will be a halo of light around the color image.

1. Cut, weed and prespace Translucent Film Image (D).
2. Prep the Clear Substrate (C).
3. Apply Translucent Film Graphics (D) to front of the Clear Substrate (C).
4. Reverse cut, weed and prespace in Black Blockout Film (B) the same image as was used with the Translucent Film (C).
5. Apply the Blockout Film Graphic (B) to the back of the Clear Substrate (C). Make sure that it is properly aligned with the Translucent Graphics (D) that was applied to the front of the substrate.
6. Apply Diffuser Film (A) to the back of the Blockout Film (B).
7. Apply GPS Film (E) over the Translucent Film (D) if you need maximum graphic protection.
Neon effect at Night

With this special effect technique, your customer will have a background that appears white by day. At night, the color image will appear to glow, giving the appearance of a neon sign.

Second Surface Application

1. Reverse cut, weed and prespace image in black blockout film (D).
2. Prep back of the clear substrate (B) and apply black blockout film (D) to back of clear substrate.
3. Apply color translucent film (C) to back of blockout film (D).
4. Apply diffuser film (A) to back of color translucent film (C).
Hidden Message Until Illuminated

Turning internal lamps off and on, changes the message with this easy-to-make special effect sign. Part of the message is hidden until illuminated. Use a color background that best meets your customer requirements for aesthetics and impact.

First Surface Assembly

1. Reverse cut, weed, and prespace image in Black Block-Out Film (C) and apply to back of Clear Substrate (B).
2. Apply Diffuser Film (A) to back of Black Block-Out Film (C).
3. Cut, weed, and prespace image Color Translucent Film (D) and apply to front of Clear Substrate (B).
4. Apply Graphic Protection Film (E) over Color Translucent Film (D) if you need maximum graphic protection.
Transmissive and Reflective at Night

With 3M™ Scotchlite™ Reflective Sheeting in the dark or low-level light, incoming light rays from vehicle headlights strike the sheeting and are reflected back to the light source for visibility and message effectiveness. For internally-illuminated signs, 3M™ Scotchlite™ Diamond Grade™ Reflective Sheeting is also transparent to the internal light, providing the double visual impact of reflectivity and internal illumination.

4 - Transmissive and Reflective at Night

Day

Night

Second Surface Assembly
1. Prepare Clear Substrate (B) and apply Reflective Sheeting (A) to front of Substrate (B).
2. Cut, weed, and prespace image Color Translucent Film (C) and apply to front of Substrate (B).
Dual Color - One Color by Day; Different by Night

With this special effect technique you can fabricate signs that appear to have a one color by day and a different color by night when internally illuminated.

Day

Night

How to Construct Backlit Sign Faces

5 - Color by Day/Different Color by Night
Combined First & Second Surface Application

First Surface Assembly
1. Prepare Clear Substrate (A) front and back
2. Apply Diffuser Film (C) to back of Clear Substrate (A).
3. Apply Color Translucent Film (B) to Diffuser Film (C).
4. Apply Colored Perforated Film (E) to front of Clear Substrate (A).
5. Cut, weed, and prespace image in White Block-Out Film (D) and apply to Colored Perforated Film (E).
6. Apply Graphic Protection Film over White Blockout Film (D) if you need maximum graphic protection.
One Image by Day; Different Image by Night

With this special effect technique you can fabricate signs that appear to have a colored image by day and a different colored image by night when internally illuminated.

Day

Night

First Surface Application

Second Surface Assembly

1. Prepare Clear Substrate (A) front and back
2. Apply Printed Perforated Film (E) to front of Clear Substrate (A).
3. Apply Diffuser Film (C) to back of Clear Substrate (A).
4. Reverse cut, weed, and prespace image in Black Block-Out Film (D).
5. Apply Black Block-Out Film to Diffuser Film (C).
6. Apply Color Translucent Film (B) to Black Block-Out Film (D).
7. Apply Graphic Protection Film over Printed Perforated Film (E) if you need maximum graphic protection.
How to Construct Backlit Sign Faces

Special Effect Films

Dual Color Film Series 3635-200
This perforated film series offers unique special effects creating one color during the day and another at night. Refer to 3M Product Bulletin 3635-200 for construction options.

Chrome Graphic Film 3635-110
This film offers a chrome-like appearance during the day and illuminates the white at night when backlit. Refer to 3M Product Bulletin 3635-110 for construction options.

Blockout Film Series 3635-20b/22b
Available in white or black, this film is used to create opaque areas on a backlit sign face. Refer to 3M Product Bulletin 3635 for construction uses.

Light Enhancement Film (LEF)
Highly reflective white film intended for use on the interior surfaces of sign boxes. LEF is used to improve the light efficiency of sign boxes. Refer to 3M Product Bulletin 3635-100 for construction uses.

Printing or Imaging Methods

Maximizing Image Quality
Most customers expect the backlit image to look like the daytime reflective lit image. It is more difficult to create a successful backlit graphic than an opaque graphic. Additional image density/color is required to achieve a similar daytime/nighttime appearance. However, you must consider all of the following points and work to balance them until you achieve the desired results. We encourage you to experiment with multiple options to determine the best one for each of your customers’ needs.

- Digitally printed large areas of solid color, unless they are all pastel, generally two imaging film or ink layers to achieve sufficient image density.
- Very bright or dark images, when digitally printed, need two imaging film or ink layers to achieve sufficient image density.
- For any type of printed image, busy images are usually most successful, but digitally printed dark or bright images still need two imaging film or ink layers.
- Only a single film layer is needed when using color translucent film, but two layers may used constructions, if desired.
- Inconsistent light distribution within the light box may be more noticeable when the image has a lot of variations in light and dark colors. To help reduce this problem, distribute the light evenly within the light box, use 3M™ Light Enhancement Film or add film diffusers.

Digital Inkjet Printing
Refer to the ink’s 3M Product Bulletin for detailed printing recommendations. DO NOT exceed the total ink coverage recommendations in an attempt to increase image density. This will cause other performance problems.

Screening Patterns for Double Layer Backlit Signs that Minimize Moiré
When screen printing 3630/3730 Series Film, two screen-printed films placed in close proximity to each other may create a moiré pattern that is visible when viewing the sign face. To minimize the moiré effect select different screen angles for the different film layers.

Overlaminates

Applying an Overlaminate with a Laminator
An overlaminate can be applied with a roll laminator if you allow the assembled backlit film/substrate construction to dry for at least 24 hours and your laminator can handle the thickness and rigidity of the construction. See 3M Instruction Bulletin 4.22.
Inkjet Graphics, Cut Graphics, or Screen Printed Graphics

Use of an overlaminate is optional, but recommended, on most inkjet graphics as well as colored or screen printed graphics. An overlaminate can be used to change gloss. It also provides protection from abrasion and UV light, and may increase the warranted durability of a graphic. Refer to the film’s 3M Product Bulletin for details.

General Assembly

Key Graphic Construction Tips

Keep these key application tips in mind before and during application.

1. **Clean the work area.** Make sure the work surface and surrounding area are properly cleaned to avoid contaminating the graphics.

2. **Temperature.** Make sure the film, air and surface temperatures are between 60 and 100 °F (16 and 39 °C).

3. **Wet application method.** Use the detergent and water application method. Lack of application fluid may cause dark marks that are visible in transmitted light.

4. **Handling paper liners.** If the film you are using has a paper liner, DO NOT allow the liner to get wet before removing it from the film. A wet paper liner is difficult to remove.

5. **Seams and overlaps.** Seams can be made using the overlap method. See “Constructing Proper Film Overlaps (Seams)” on page 24.

6. **Applicator tools.** Use plastic applicator PA-1 that is smooth and not nicked. To initially flatten and adhere the film, a large window squeegee may be used with light pressure. The final squeegeeing must be done with a PA-1 squeegee covered by a low friction sleeve SA-1.

7. **Squeegeeing.** Review the “Squeegee Techniques and Squeegee Procedures” on page 22.

8. **Puncture air bubbles** using a pin or air release tool, do not use a knife or blade. “Removing Bubbles Under the Film” on page 22.

9. **To remove an application tape,** if used, always peel it back on itself – as close as possible to 180 degrees – and immediately re-squeegee the film.

10. **Cut and weed** within one hour after application, for the best results. See “Cutting and Weeding After Application” on page 27.

11. **Keep newly fabricated sign faces in ambient shop temperatures for at least 24 hours.** This allows any remaining moisture to diffuse through the film.

12. **Resqueegee the edges** 24 hours after fabricating the sign face.

13. **When using 3M Flexible Substrates** in your construction, please refer to 3M Instruction Bulletin 5.30 for additional details to help ensure a successful application.

**CAUTION**

Any activity performed for a long period of time in an awkward position or with a high amount of force is potentially a risk for causing musculoskeletal strain, pain or injury. When applying graphics, follow these practices to improve comfort and avoid injury.

- Alternate your tasks during the application.
- Schedule regular breaks.
- Perform stretches or do exercises to improve circulation.
- Avoid awkward reaching.

Prep and Clean the Substrate

1. **For plastic substrates.**

   Plastic substrates (also called plastic sheet or rigids) have a protective covering. Be sure you peel it off and remove all traces of the adhesive. Then clean the substrate following the instructions below:

   - Oven dry polycarbonate substrate before applying the film. Use the method, time, and temperature recommended by the plastic manufacturer. Failure to properly dry the plastic can result in trapped water migrating to the surface of the material, which may cause the film to bubble.
IMPORTANT NOTE

High temperature copolyesters and most acrylic substrates, generally, need no pre-drying. Consult your plastics manufacturer.

2. For 3M Flexible Substrates.
   Clean as instructed below before applying any film.

CAUTION

Before handling any chemical products, always read the container label and the SDS.

3. Clean the substrate.
   Consider all substrates to be contaminated and clean immediately prior to application.
   a. Wash the substrate with a synthetic, free rinsing detergent. DO NOT wash the substrate with a soap or detergent containing cream or lotion.
   b. Dry the substrate with a lint free paper towel before the solvent evaporates.
   c. Wash the substrate a final time with a cleaning solution of 70% isopropyl alcohol and 30% water.
   d. Saturate a clean paper towel/wipe with the 70/30 solution and immediately wipe the substrate dry and clean.

Assembly Preparation

1. Make the Wetting Solution.
   • Use a mild liquid dish detergent (not soap) that contains no creams or fragrance. Additives to the detergents will interfere with the bond of the adhesive.
   • Make a wetting solution using mild liquid dish detergent and one quart of cool water.
     - Concentrated Detergent = 1/2 teaspoon per quart of water.
     - Non-Concentrated Detergent = 1 teaspoon per quart of water.
   • For further details, see 3M Instruction Bulletin 5.1. Select and Prepare Substrates for Graphics Application.

2. Proper Liner Removal and Wetting of the Adhesive.

   a. Place the film so it is liner-side-up on a clean light table.
   b. When holding the film down to remove the liner, avoid placing your fingers on the adhesive edge of the film. Fingers on the adhesive edge of the film may contaminate the adhesive and lead to lifting of the film or poor adhesion of the film to the substrate.
   c. Lift one corner of the liner while spraying the wetting solution onto the exposed adhesive. See Figure 5. If the film has a paper liner, avoid wetting the paper liner. Wetting the paper liner may cause it to separate and make it difficult to remove.
   d. Continue removing the liner and spraying the solution. By the time the liner is completely removed, the entire adhesive surface should be wet. Spray on more solution if necessary.

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Figure 5. Remove the Liner, Wet the Film
Squeegee Techniques and Squeegee Procedures

3. Proper Squeegee Technique. See Figure 6.
   a. Always squeegee across the shortest distance (center to edge). Start in the center of the graphic and squeegee straight out to one edge. DO NOT use an arcing stroke that may trap the wetting solution and air.
   b. Return to the center and squeegee to the opposite edge.
   c. Return to the center and start the next stroke so it overlaps the previous one by about 50 percent.
   d. Continue moving up the graphic, return to the center of the graphic, and continue down until the film is completely adhered.

![Figure 6. Typical Stroking Sequence for Squeegeeing](image)

Proper Technique without Premasking Tape

   a. To avoid friction, spray additional wetting solution onto the surface that you will be squeegeeing.
   b. The first time over the film a large window cleaning squeegee can be used to smooth out wrinkles and remove much of the application solution. A large, nick-free window squeegee can do this quickly. If a large amount of film builds up ahead of the squeegee, use your hand to push out the excess water and smooth the film. Then continue with light overlapping strokes across the entire graphic.
   c. Go over the film again with a standard four-inch squeegee with a low friction sleeve using firm squeegee strokes.
   d. Dry the graphic with a lint-free clean cloth or soft paper toweling. Be sure to absorb the moisture along the edges, too.

Proper Technique with Premasking Tape

   a. Follow the same squeegee technique using firm strokes with a four inch squeegee.
   b. Remove the premasking tape at 180 degree angle.

Finish the Squeegee Procedure

   a. Re-squeegee the entire graphic until all water is removed between the image and the spacer. This may require going over the graphic several times. If needed, use a little of the detergent and water solution to lubricate the squeegee.
   b. If the application has bubbles, see “Removing Bubbles Under the Film” below.
   c. Check for good adhesion by trying to lift a corner.

4. Re-squeegee After 24 Hours.
   After 24 hours at room conditions, re-squeegee all film edges. Use a low friction sleeve SA-1 on the applicator to prevent scratching.

Finishing Techniques

Removing Bubbles Under the Film

1. To remove entrapped bubbles, puncture the film at one end of the bubble with a pin or other sharp, round pointed tool, such as air release tool 391X. Press out the entrapped air or wetting solution with the thumb or squeegee, moving toward the puncture. See Figure 7.
IMPORTANT NOTE

Do not use a knife or razor blade to puncture the film, slitting a bubble with a knife or a blade may create an opening which will eventually become a light leak.

2. Some bubbles may be removed by spraying the top area with solution and squeegeeing it out with rapid strokes of the squeegee.

![Figure 7. Using a Pin to Remove Bubbles](image)

Assembly Method: Single Panels with No Overlaps

IMPORTANT NOTE

This example is based on Option 1, Non-Printed, Color Translucent Film, First Surface of a clear rigid substrate. Each film layer is applied one at a time using the wet method. Adapt this procedure for your specific construction.

1. Be sure you have followed the instructions in “Prep and Clean the Substrate” on page 20.
2. Remove the film liner wetting the adhesive on the diffuser film as you go.
3. Thoroughly flood the second surface of the substrate with wetting solution.
4. Position the adhesive side of the diffuser film against the second surface of the plastic substrate.
5. Wet the top of the diffuser film.
7. Turn the substrate over so the first surface is facing up.
8. Remove the film liner, wetting the adhesive on the translucent film as you go.
9. Thoroughly flood the first surface of the substrate with wetting solution.
10. Position the adhesive side of the translucent film against the substrate.
11. Wet the top of the translucent film. Squeegee thoroughly.
12. If you are using an overlaminate:
   a. Remove the liner as you wet the adhesive on the overlaminate.
   b. Thoroughly flood the translucent film with wetting solution.
   c. Position the adhesive side of the overlaminate against the translucent film.
   d. Wet the top of the overlaminate. Squeegee thoroughly.
13. **Re-squeegee all edges after 24 hours.**
14. Mount the construction in the light box.
Constructing Proper Film Overlaps (Seams)

For most digitally-imaged graphics, you can create multi-panel signs. However, construction of proper overlaps (seams) is required to prevent light leaks and maintain eligibility for 3M warranties.

- Digitally-imaged film may shrink after installation.
- If the film shrinks at a seam, there will be a light leak that is usually unacceptable.
- The appearance of light leaks can be reduced or eliminated by creating an overlap at the panel seams. The seam will appear darker than the rest of the image, especially when backlit, but it is generally more acceptable than a light leak. This is the only method recommended by 3M.

Two Films - Single Seam

- Overlap colored translucent and digitally printed panels by 3/16 to 1/4 inch.

![Figure 8. Recommended Film Overlaps](image)

- Do not use a combination of seam directions. Use only horizontal or only vertical seams in one sign. If you are making horizontal seams, lap the top panel over the bottom panel (rain lap).

Multiple Film Layers - Multiple Seams

- Seams for each layer of film, diffuser and/or overlaminate must each be offset by at least 1/4 inch. Figure 9 illustrates the preferred method of offsetting the overlaps. This method eliminates all gaps except the one in the bottom layer of film and creates a better sealing seam.

![Figure 9. Offset Overlaps Required for Each Layer](image)
Cutting and Weeding After Application

For the best results, cut and weed the film within 1 hour after application. The adhesive bond builds with time and weeding becomes more difficult.

1. Cutting may be done with conventional graphic knives, either fixed or swivel, or with a sharp razor blade in a safety holder.
2. Patterns may be placed on the surface of the applied film by pouncing with chalk or carbon dust. Some carbon papers and some graphic pens may permanently mark the film so check suitability before using.
3. Avoid or minimize over cuts to eliminate light leaks.
4. To weed, carefully pick up a corner of the weed and pull with sharp, short jerks at a shallow angle. If adhesive transfers to the substrate during removal, warm the surface slightly during removal to reduce the amount of transfer.
5. Any adhesive left on the substrate may be removed by rubbing with the thumb or finger.

Installing Decorated Substrate in Sign Frames

Graphics cut flush with the edge of a rigid substrate can be damaged from handling or when mounting the sign frame. Two methods to protect the edges of the decorated plastic substrate to reduce the chance of damage when installing it in a sign frame are:

1. Trim away the film at least 1/8 inch from the edges of the substrate all around the graphic. The trimmed area will be hidden by the retainer.
2. Apply a clear protective tape to the edges of the graphic to reduce the risk of film damage due to constant rubbing.

Use care when inserting the sign face into the sign frame to ensure that sharp edges do not catch or tear the film.

Warranty and Limited Remedy

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