



Product & Instruction Bulletin UV Clears

Release A, Effective March 2012

See PB 9800 for 3M™ Screen Print UV Gloss Clear 9800

3M™ Screen Print UV Gloss Clear 9740i

3M™ Screen Print Matte Clear 9730UV

Clear 9740i directly replaces 3M™ Screen Print UV Gloss Clear 9720i and 3M™ Screen Print Gloss Clear 9720UV

A UV-cured Clear for Inkjet Printed or Screen Printed Graphics

1. Product Description
These are high-performance, ultraviolet-cured clear coats designed for use on most 3M brand graphic films that are printed with inkjet inks or screen print inks. Use these weather-resistant clears for both indoor and outdoor graphics to provide a tough, flexible, chemical-resistant and abrasion-resistant coating on flat, corrugated and/or riveted applications.
2. Recommended Types of Graphics and End Uses
Refer to the base film's Product Bulletin for details on specific constructions and any warranty that may apply when using this product.
 - To protect indoor and outdoor graphics.
 - For graphics used in a petroleum environment where staining is not a concern.
 - A. Limitations of End Uses
3M specifically does not recommend or warrant these uses, but please contact us to discuss your needs or recommend other products.
 - Transit-mix cement trucks or other vehicles frequently washed with concentrated, strong acids or aluminum brighteners.
3. Compatible Products
Refer to the Product Bulletin for the base film you are using to determine compatibility and graphic construction options, including which application tape to use.
4. Warranty Information
 - Warranty Coverage Overview
Both the warranty coverage and the durability for each graphic are 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 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 the base film Product Bulletin.
 - (1) Direct Replacement
Clear 9740i directly replaces clear 9720i and clear 9720UV. To determine the Warranted Durability for the graphic in its intended application, refer to the Warranted Durability listed for clear 9720i or 9720UV in the base film Product Bulletin if clear 9740i is not listed.
 - (2) Blending Clears
Clears 9730 and 9740i can be blended to achieve a custom gloss for use over 3M™ Screen Printing UV Ink Series 9800. If you blend these clears, the warranty is the same as for clear 9730.
 - Warranty Limitations
Graphics are not warranted against fading, cracking, peeling, lifting or discoloration due to:
 - Severe abrasion.
 - Staining from cleaning solutions, engine fuels, exhaust, or organic solvents.

5. Health and Safety



CAUTION

Refer to the package label and the Material Safety Data Sheet for health, safety, and handling information on the products referenced in this bulletin. For 3M products, if necessary, you may contact our Toxicology/Product Responsibility Department on 01344 858000.



WARNING

Observe safe operating procedures when using UV cured clears. Provide adequate ventilation and wear appropriate gloves and other protective clothing to avoid all skin contact. Refer to the Material Safety Data Sheets (MSDS) for details.

6. Considerations for Printing Graphics

A. Digital UV Ink

When printing with UV ink, the ink may need to be cured at or slightly below the minimum recommended cure dose in order to get adequate adhesion of the clear. Keep in mind that the ink will receive an additional cure dose as the UV clear is processed. Refer to the Product & Instruction Bulletin for the 3M ink you are using for general curing dose recommendations.

Note: To achieve the highest clear coat adhesion, apply the clear within 3 days after printing.

B. Digital Solvent Ink

For images with a heavy solvent ink laydown to which a UV clear coat is applied, additional limiting of total ink coverage and/or additional drying time may be needed. The following test helps determine the maximum possible ink laydown and/or adequate drying to ensure that a UV clear coat is successfully applied.

1. Print a test image.
 - a. Use the film and ink and image you plan to use for production.
 - b. Use a range of total ink coverage percentages.
 - c. Use the proper printer production default settings that are optimum for the film and image you are printing.
2. Apply the UV clear.
 - a. If the clear-coated surface blisters or has low gloss while curing the UV clear, it is probably due to excess solvent from the inks still retained in the film. The range of ink laydowns in the test will show at what point the blistering starts.
 - b. Check to be sure that the clear is not excessively tacky.

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3. Reduce retained solvent.
 - a. Preferred method: Reduce the total ink coverage by using ink-limiting features in the image processing software.
 - b. Optional method: Evaporate the solvent more thoroughly by using options available for your printer (if any). This may include running the film through the dryer multiple times, increasing dryer temperature, rack drying over an extended period, etc.
4. If blistering or gloss loss still occurs, cure at the lower end of the cure level spectrum. See below.

C. Screen Print UV
Ink Series 9800

Cure the ink at the lowest possible setting to ensure that it or the film is not over cured. Excessive UV exposure during printing can prevent the clear from adhering properly.

(1) Printing with 6 or more
colors

Multi-pass, screen print jobs that use 6 or more colors should be checked carefully to ensure the film and printed colors have not been overexposed leading to poor clearcoat adhesion. See page 6 for details on how to test for overexposure.

D. Screen Print
Solvent Ink Series 1900

If the image has heavy solvent ink laydown, further ink limiting and/or additional drying may be needed to avoid solvent blistering during the UV curing process for the clear.

7. Preparing the Clear

A. Typical Coverage

Typically, 1 U.S. gallon (3.8 liters) of the clear covers 2500 to 3500 square feet (59 to 83 square m/l) with a 150 tpc twill weave mesh. However, several elements affect the coverage:

- Screen mesh and type
- Hardness (durometer) of the squeegee
- Angle of the squeegee
- Emulsion thickness

B. Mixing

Mix the screen print clear for 10 minutes to get an even distribution of all components. Some separation of the components is normal during storage.

Use a high-speed power mixer with a blade 1/3 to 1/2 the size of the container. If the blade is smaller than this, make sure to move it around in the container. Put the blade 2/3 of the way into the liquid.

A paint shaker can also be used. Mix for 15 to 20 minutes.

8. Applying the Clear

A. Frame

Use a rigid, metal frame. Include a 6 to 10 inch (15 to 25 cm) well between the frame and the graphic design on all sides.

B. Fabric

Fabric selection is critical. Choose a fabric that lays the clear to a **thickness of 6 to 12 microns**. Dynamesh, Saati and Tetko companies all make suitable fabrics.

- Use a monofilament thread, plain or twill weave fabric.
- Use a PE355T to PE420T (140 to 165 tpc) or any fabric that maintains a theoretical ink volume of 0.35 to 0.69 cubic inches/square yard (7 to 13.5 cm³/m²). A thicker screen print clear coating produces a smoother and glossier graphic. The thickness of the screen print clear will be 6 to 12 microns, depending on the fabric used.

Note: Thicker clear coats may reduce the flexibility and extensibility of the graphic construction, leading to problems such as cracking around rivets or excessive film tearing during removal (where applicable).

- Use a thread with a diameter less than 31 microns. The total fabric thickness should be less than 50 microns.

Note: Calendared fabrics, twill weaves and thick threads affect the ink lay down and cause printing and curing problems.

C. Stencil

Use a photographic or hand-cut stencil that is water-soluble and resistant to ketones and strong lacquer solvents.

D. Squeegee

Multiple durometer squeegees (70/90, 65/95/65, 70/90/70 or 75/95/75) provide the best results. A sharp squeegee with an 80 durometer or harder plastic blade will also work.

Note: A softer squeegee increases the clear lay down and can make printing more difficult.

Use a squeegee large enough to overlap the design by at least 2 inches (5

cm) on each side.

Set the squeegee angle to as near vertical as possible. Do not let the angle to the horizontal be less than 80 degrees. The exact angle may vary because of press design.

Note: A lower angle may result in a heavy clear lay down. This may cause curing problems.

E. Screen Printing Method

Use the off-contact screen printing method to produce a uniform impression. Make a fill pass and then make the impression pass.

F. Roller Coating Method

- This clear is designed for screen printing but can be roll coated with equipment that is designed to handle high viscosity materials.
- Do not thin the clear as this will affect the final properties of the cured graphic.
- Apply the clear to achieve a 6-12 micron coating weight. If there is non-uniformity in the coating weight, the thinner areas must still meet the minimum 6 microns thickness.

9. Curing Methods



CAUTION

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

A. About Curing

- Best results are obtained by curing immediately after screening. Placing the sheets in a drying rack or delaying the curing process may cause an undesirable surface appearance.
- Using the curing ranges specified ensures proper curing. Too low of an energy level may result in a wet and tacky print.
- Too high a cure energy may lead to blistering of underlying ink, excessive yellowing of the clear, or embrittlement of the clear.
- High substrate temperatures associated with the UV curing process may cause a decrease in gloss due to residual solvent coming out of the inkjet printed film. This effect will be most noticeable in darker, heavy ink laydown areas. The effect can be minimized by reducing the amount of ink laydown (see *Considerations for Printing Graphics*, page 2) and reducing heat generated during curing (see below).
- If there is still blistering after minimizing the amount of retained solvent during printing, try the following:
 1. Reduce the base film temperature during curing such as by increasing ventilation in the curing unit.
 2. Reduce the cure dose to the lower level of the range. See Table 1 on page 5.
 3. Run at a higher belt speed during the curing process (at the same overall dose).

Example: A lamp intensity of 300 watt/in with a belt speed of 150 ft/min to give a UVA cure dose of 175 mj/cm² would be preferred over a setting of 200 watt/in lamp intensity with a belt speed of 100 ft/min that also gives UVA cure dose of 175 mj/cm².

B. About the Color of these Clears

These clears have a slightly yellow tint that increases as the energy level used to cure the clear and/or the amount of heat the graphic is exposed to increases. Exposing the graphic to outdoor ultraviolet light will photo-bleach most of the tint within a few days. Fluorescent lights will also photo-bleach most of the tint, but it will take a longer period of time.

C. Focused-lamp Curing Unit

(1) Specifications

Focused-lamp cure units use high concentrations of ultraviolet light to initiate polymerization.

- Use a cure unit lamp that has an energy output of at least 200 watts per inch (wpi). If using lower wattage bulbs and slower speeds, there is a risk of generating too much heat and causing a gloss change and/or blistering.
- Bulbs must have adequate energy in the 230-350 nm range to cure the clear correctly.
- Bulbs need to produce a UV Peak irradiance of 600 milliwatts/cm² (mW/cm²).
- Do not use ozone-free or doped bulbs. These bulbs may not produce the correct wavelengths to properly cure the clear. Some quartz IR filters can also interfere with the cure.
- The UV energy output of the cure unit must be accurately measured.

We recommend the following radiometers:

- (1) Kühnast UV Integrator (250-410nm) which is available from Kühnast Strahlungstechnik, GmbH, Poststr. 56, 633607 Wächtersbach, Germany.

Web Site: www.uv-technology.de

Or

- (2) Uvicure™ Plus UVA/High Power (315-400 nm) radiometer, which is available from:
EIT Corporation, 108 Carpenter Drive,
Sterling, VA 20164, USA.

Web Site www.eit.com

(2) Operation

- The energy levels should be uniform across the entire web. Energy levels could be significantly lower at the web edges. Do not clear coat graphics that are wider than the width of the uniform output of the lamps.
1. Measure the UV lamp energy and irradiance levels at the beginning of every working day and whenever adjustments are made to the unit.
 2. Allow the lamps to heat up for at least 10 minutes or until the indicators show that the lamps have stabilized.
 3. Replace bulbs according to the bulb manufacturer's recommendations. Dirty lamps and reflectors or bent reflectors prevent the ink from curing properly.
 4. Adjust the lamp wattage and/or belt speed to get the specific energy level on the radiometer. These are the recommended cure levels for the Uvicure® Plus Radiometer:

a. TABLE 1
Recommended Cure Levels
millijoules/cm² (mJ/cm²)*

Calibration Standard for Uvicure® Plus Radiometer

Clear	Graphic Type	Target	Range
9730UV	Digital	280	150 to 310
9730UV	Screen Print	280	250 to 310
9740i	Digital and Screen Print	200	150 to 250

Calibration Standard for Kühnast UV Integrator

Clear	Graphic Type	Target	Range
9730UV	Digital	310	180 to 350
9730UV	Screen Print	310	280 to 350
9740i	Digital and Screen Print	230	180 to 280

5. Test the clear to make sure that it is properly cured. Test methods are outlined in the *Testing* section.

6. Adjust the unit until the clear is correctly cured.

10. Testing

Maintain a testing log for future reference. Clear coating must pass these 3 tests:

- Appearance Test
- Abrasion Resistance Test
- Tape Snap Adhesion Test

A. Appearance Test

These are the surface characteristics of properly cured UV Clear.

- High gloss, except for clear 9730UV, which is matte
- No wet or tacky areas
- Does not surface impress once sheets are cool

B. Abrasion Resistance Test

1. Make press adjustments to produce an acceptable wet (uncured) print.
2. Print a production sheet of film and pass it through the UV curing unit.
3. Try to scrape the clear from the surface with a coin. If the clear scrapes off:
 - a. Check to make sure the press conditions follow the recommendations.
 - b. Reduce the clear thickness:
 - Use a harder squeegee
 - Set the squeegee angle closer to vertical
 - c. Increase the energy level, slow the belt speed slightly.

4. Repeat steps 2 and 3 until the clear passes.

Note: Increasing the energy level beyond the recommended curing range may cause the clear to fail the Tape Snap Adhesion Test.

C. Tape Snap Adhesion Test

The Tape Snap Adhesion Test determines if the clear is over-cured or if the film or ink has been overexposed or over-cured. It tests the adhesion of the clear to ink and the adhesion of the clear to the film.

Passing the ink and/or film through the curing unit several times when multi-color screenprinting may change the surface characteristics of the ink or film resulting in adhesion failure. Testing simulates the process and allows you to adjust the process and prevent adhesion failures.

- (1) Frequency
 - a. Printing with 6 or more colors
- (2) Procedure

Test daily on several areas on the film.

Be sure to conduct this test daily on all colors exposed to 6 or more cure passes.

1. From the start of the print run, set aside enough production material to test the clear.

Note: You can also use misprinted material produced during the print run.

2. Print the clear on the test material.
3. Cure at the level for the screen print clear.
4. Use the point of a sharp razor blade, knife or other suitable instrument to scratch a crosshatched pattern through the clear. Do not cut into the film. Be sure to scratch areas where the clear is applied over printed ink and film.
5. Use 3M™ Hand Applicator PA-1 to firmly apply a 1-inch wide strip of Scotch™ Tape #610 over the crosshatched areas.
6. Remove the tape by pulling it back upon itself using a rapid, firm pull.
7. No separation should occur between the clear and the inks or between the clear and the film.
8. If the layers separate, decrease the energy level by increasing the belt speed slightly.

Note: The clear must still pass the Abrasion Test and Appearance Test after making any adjustments.

9. Repeat steps 1 through 8 until a sample passes the adhesion test.
10. If you have made adjustments and still cannot get the clear to adhere, call 3M Technical Service for directions before continuing.

11. Cleaning Graphics

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 general maintenance and cleaning information.

12. Shelf Life, Storage and Shipping

A. Shelf Life

- Use by the expiration date shown on the product packaging. A Use By Date, such as 01Dec2012, is on the ink container product label, as well as the outer shipping carton.
- Do not use a clear that shows signs of gelling.
- Liquid clear can vary in color, depending on age and storage conditions. The color does not affect the performance or cured color of the clear.

B. Storage Conditions for Clear

- 32° to 80°F (0° to 27°C) maximum. Do not freeze. Warmer storage conditions will reduce the shelf life.
- Out of sunlight, mercury vapor lamps, quartz-halogen lamps, or arc lamps.
- Clean dry area.
- Original container or other sealed polyethylene container that is UV opaque; do not store in glass or metal containers.

C. Shipping Finished Graphics

- Be sure the ink and clear are cured before packaging the finished graphic.
- Put a slip sheet, such as 3M™ Easy Release Liner SCW-33, on the printed side of the following types of graphics:
 - a graphic that is pre-mounted on panels.
 - panels that have graphics on both sides.
 - a liner that is printed by the printer.
- Ship the finished graphic lying flat or rolled. To roll, wrap the graphic film-side out onto a core that is 5 inches (13 cm) or larger in diameter. This helps prevent the liner and premasking tape from wrinkling or popping off.
- Store finished graphics in a clean, dry area, out of the direct sunlight and at a temperature less than 100°F (38°C).
- See Instruction Bulletin 6.5 for details.

13. 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 www.3m.co.uk/graphicsolutions

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.

Subject

Films, Inks and Clears

Please visit our website, www.3m.co.uk/graphicsolutions to identify and obtain the additional Product and Instruction Bulletins you need for a successful application.

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