



### Suggested Uses:

Norcote® MI Series is a UV Curable ink system designed for second surface decoration of PC, treated PET, and other plastic films used in Insert-Mold Decoration applications. MI Series inks have excellent flexibility and durability and are suitable for use with most Forming, Trimming and Injection Molding processes. This product contains NVP. **It is the responsibility of the end user to pretest all substrates with Norcote® products prior to use in production.**

### Product Features

- Low Tack
- Excellent Flexibility/Formability
- Excellent Adhesion Bond with Injected Resins\*
- Excellent Printability/Definition
- Excellent Washout Resistance
- Compatible with a wide range of materials

\*When used as directed with a Tie-Coat or Two Layer Construction

### Printing Recommendations:

All inks are supplied at print-ready viscosity, but should be thoroughly mixed prior to each use. When using a power mixer avoid using dispersion mixing blades, especially with metallic mixes. The MI Series requires the use of a Tie-Coat/Single Layer Construction (SLC) or Two Layer Construction (TLC) to promote ink and resin adhesion.

### TLC / Laminate Construction

A Two Layer Construction/Laminate construction is a type of construction where a film is laminated to the back of a decorated part. When using demanding or complex tooling, a Two Layer Construction can offer better forming and molding performance.

### Single Layer Construction

Single Layer Constructions are those where the resin is injected directly on a printed ink film-whether it is a tie-coat or graphic ink.

### Mesh:

Low elongation monofilament polyester mesh is recommended with mesh counts of 230 to 460 threads per inch (90 to 180 threads per centimeter). Tension should range from 18 to 30 Newtons/cm<sup>2</sup> on rigid frames. Different mesh counts can be used to adjust ink film deposit to allow for better forming performance depending on the forming tool design. Refer to the Forming/Embossing section in this technical sheet.

### Stencil:

Use of UV compatible direct and thin capillary films (13-25µ) are recommended.

### Squeegee:

80 shore durometer polyurethane squeegees are recommended.

### Cure & Adhesion:

The MI Series was designed to cure with focused medium pressure mercury vapor lamps. A minimum dosage of 185 milli-Joules per square centimeter with an intensity of at least 800 milli-Watts per inch is recommended to ensure adhesion to most substrates. A curing system with one medium pressure mercury vapor lamp capable of 300 watts per inch output and a focused reflector should provide adequate cure to the ink. Care should be taken not to cure the product too slowly as it may degrade the ink film or substrate. Cure speeds of the MI Series depend on the ink film thickness and the energy output of the lamps. Ink should be cured immediately after printing. As all UV curing systems vary, thorough testing should be conducted.

### Screen Cleaning:

Alcohol based solutions must be avoided as they break down the emulsion. Norcote recommends Press Wash 110 (flash point 113° F), 140 (flash point 140° F) or NSW-824 (flash point 150° F).

### Coverage:

Ink coverage is based on theoretical ink film thickness. The MI Series is a 100% solids printing ink. Estimated coverage is approximately 200 m<sup>2</sup> (2,200 ft.<sup>2</sup>) per gallon depending upon ink deposit.

### Precautions:

Gloves and / or barrier cream is recommended when handling UV inks. Safety glasses are suggested, particularly for areas where ink may be splashed. If skin contact occurs, wash affected area with soap and water-do not use solvents or thinners.

### Description of Application:

Insert-Mold Decoration (IMD) is a term used to describe a process in which a plastic film is decorated on the first or second surface, formed to a three dimensional shape, trimmed, and then injection molded with a polymer resin. The resulting part is a three dimensional, decorated plastic component where the graphic image is bonded between the graphic film and injected resin. IMD applications are used in the manufacturing processes for Electronics, Appliance, Automotive, Telecommunications and Medical parts and components. IMD applications can be processed with and without a Two Layer Construction (TLC). For complex tooling designs, a Two Layer Construction may prevent issues with respect to gate wash, ink film cracking and poor resin bond. Parts designed with less complex tooling can be achieved with a Single Layer Construction.

## Typical Curing Parameters:

2 Focused lamps	1 Focused lamp
200 Watts per inch	300 Watts per inch
80-120 feet per minute (25-40 meters per min.)	60-80 feet per minute (20-25 meters per min.)

## Material Selection:

MI Series inks have excellent adhesion to a wide variety of polycarbonate, polycarbonate / polyester blends and polyester films. These substrates include:

GE	Bayer	Autotype
Lexan <sup>®</sup>	Makrofol <sup>®</sup>	AutoForm <sup>®</sup>
Tru 2 Form <sup>®</sup>	Bayfol <sup>®</sup>	Hi-Form <sup>®</sup>
Valox <sup>®</sup>		
Xylex <sup>®</sup>		

The use of ADH-067 may offer adhesion to additional substrates including:

\*Acrylic \*Polyethylene \*Polypropylene

Adhesion to substrates should be evaluated using a Cross Hatch Tape Test (ASTM D3359) incorporating the use of 3M 600 tape. Allow the printed part to cool to room temperature prior to performing the test.

## Intercoat Adhesion:

MI Series inks have good inter-coat adhesion properties. It is recommended that intercoat adhesion be monitored when printing four or more passes of ink. Inter-coat adhesion is best evaluated by conducting Cross Hatch Tape Test (ASTM D3359) after each print. Care should be taken to not over-cure the ink when printing more than 5 layers of ink.

## Tack:

When properly cured, the MI Series inks will have very little tack immediately after printing. This is most noticeable in the 1019 Black and 049 Clear products. The tack is inherent in the resin system used in the MI Series and assists with the flexibility and resin bond characteristics of the ink. The level of tack subsides with time and exposure to air. Tack is not indicative of an under-cured ink film. Slower, more intense cure energy and heat can aggravate the tack characteristics. A cross hatch tape test will indicate a cure problem.

For high-speed printing processes, using an alternative stacking practice may prevent blocking problems depending on the type of substrate and the amount of sheets being stacked. Sheet stacks are recommended to be kept to a minimum for these processes. Tack has not been found to negatively affect the in-line printing processes.

## Weatherability:

MI Series inks are intended for use as a second surface graphic ink. MI Series inks are NOT RECOMMENDED FOR DIRECT EXTERIOR WEATHERABILITY.

If required, accelerated Life Tests (ALT), Environmental Life Tests (ELT) or other appropriate testing should be conducted. The MI Series inks are designed to meet some ALT/ELT test programs, but differences in test conditions vary for each individual customer. Material selection is a critical factor in ALT/ELT performance of the end product. When designing a part, select a material suitable for the end-use application, and then conduct ALT/ELT testing, if required, with the ink system. This will give the best indication as to material/ink compatibility and performance.

## Part Construction:

It is recommended that a Laminate Construction (TLC) or Tie-Coat be applied before further post-print processing. The purpose of these two systems is to promote adhesion between the ink film and the injected resin. Part construction depends on the end-use requirements.

## Laminate Constructions

A variety of materials can be used as laminate films for IM applications. It is recommended that testing be conducted to identify the correct combination of material and adhesive. Results will vary depending on application of the laminating adhesive and laminate film. It is the responsibility of the customer to determine which combination of films and adhesives work best. NOTE: 3M 467 / 468 Adhesives are not suitable for use with IM applications.

## Tie-Coat

UV curable, water-based or solvent based Tie-Coats may be used, depending on the preferences of the printer. When processing the Tie-Coat, it is recommended that the printer follow the manufacturer's recommendations for pre-press, printing and drying processing parameters. It is recommended when solvent based tie coats are used. Cure the tie coat as soon as possible to avoid the damage of the cured MI films.

## Forming / Embossing:

The MI Series has been tested and found to produce good results with many thermo, pressure and vacuum forming processes. Due to the many tooling designs in use, testing parts using a specific forming process is strongly recommended. Best results with forming occur when the correct amount of ink is applied to the substrate. When using complex forming designs, adjusting the ink film deposit can improve performance.

When using a "heated" forming process, a pre-heat is recommended for the printed sheet. In addition, the temperature of the forming tool should be no more than 150° C (300° F). Higher tooling temperatures may activate the tie-coat, if used, causing the sheet to stick to the forming tool. Refer to the substrate manufacturer for guidance on material / forming process compatibility.

## Injection Molding:

The MI Series inks require the use of a Two Layer Construction / Laminate Film or Tie-Coat prior to being formed, trimmed and molded. The injection molding environment has varying levels of shear, pressure, temperature, and flow. Due to the variations in injection molding processes, identifying the optimal parameters is key to producing a working IM part. Awareness of the variables included in this process will increase the chances for success. These include:

- Type of Injected Resin
- Mold Tooling / Cavity Temperature
- Resin Temperature
- Injection Pressure
- Gate Design (type and distance from the graphic film)
- Dwell Time

## Trimming / Die-Cutting:

The MI Series is an extremely flexible ink system providing excellent results under most die-cutting and trimming operations. For guidance, please refer to the substrate supplier and equipment suppliers' processing recommendations.

## Standard Metallic Pastes:

Metallic pastes may be added at varying percentages to any MI Series ink. Mesh counts of 305 threads per inch and below are recommended when printing metallic mixtures. Do not exceed 15% metallic paste by weight. Be sure to mix the metallic paste into the ink thoroughly. When printing metallic mixtures, adhesion and inter-coat adhesion to the substrate should be monitored. Higher percentages of metallic pastes can decrease adhesion and inter-coat adhesion properties. If intercoat adhesion is evident on a part, the use of a Clear (MI-049) flood printed after the metallic can improve adhesion performance. Mixtures of MI Series inks and metallic pastes have a reduced shelf life. Custom blends should be mixed fresh daily, if possible.

## S3100 Special Silver Metallic:

The S3100 Silver Metallic paste is to be used with any MI Series ink. This product has an increased brilliance not typical of the standard metallic pastes. Mesh counts of 305 threads per inch and below are recommended when printing metallic mixtures. Do not exceed 15% metallic paste by weight. Be sure to mix the metallic into the ink thoroughly. For storage, keep the container away from exposure to direct and indirect light and away from heat. The lid should always be tightly secured.

## 038 Silver Powder:

The 038P is a type of coated powder that is meant to line up the silver particles at the bottom of a printed and cured ink film. Because of this, it is recommended for second surface applications only. This product requires gentle mixing. It is best mixed by hand. Avoid dispersion using (toothed) mixing blades on mixers. The 038 Silver Powder should be mixed with the MI-000 Clear not to exceed 15% by weight. Be sure to thoroughly mix the powder into the Clear. Ability to cure a suspension is related to pigment load and UV exposure. Select mesh counts of 305 threads per inch (120/cm) or lower when printing a metallic mixture. Adhesion and intercoat adhesion to the substrate should be monitored throughout the production run. Higher percentages of metallic pastes can decrease adhesion and inter-coat adhesion properties. Mix ink fresh daily. Keep the container away from exposure to direct and indirect light and away from heat. The lid should always be tightly secured.

## Day-Glo Powders:

Due to post-print processing, the use of Day-Glo powders are not recommended for use with the MI Series inks.

## JZB Fluorescents:

JZB Fluorescent liquids may be used at a recommended maximum of 5% total in a custom formulation. Post-print testing, in particular, the forming and molding operations,

must be conducted and reviewed to ensure suitability for use of the JZB products prior to beginning any production runs. Printed parts should be evaluated for cracking in the ink film on forming draws and shifting of the color before and after forming and molding. If the parts do not maintain good forming and molding performance, the amount of JZB product used should be lowered or removed from the formula.

## Standard Colors:

The MI Series inks can be blended to match specific custom colors.

MI-022	Red
MI-023	Rhodamine Red
MI-024	Rose
MI-030	Emerald Green
MI-031	Spruce Green
MI-034	Permanent Blue
MI-035	Violet
MI-037	Reflex Blue
MI-112	Lemon Yellow
MI-117	Medium Yellow
MI-2872	Lightfast Orange



## Black / White / Clear

MI-000	Clear for Powders
MI-002	Mixing White
MI-005	Mixing Black
MI-049	Clear
MI-449	Non-Yellowing Clear
MI-549	Non-Blocking Clear
MI-1019	Opaque Black
MI-1046	Opaque White
MI-1446	Non-Yellowing White
MI-4000	Dense Black

## Process Colors

MI-080	Halftone Process Cyan
MI-081	Halftone Process Magenta
MI-082	Halftone Process Yellow
MI-083	Halftone Process Black
MI-060	Halftone Base

## Transparent Colors

MI-193	Transparent Green
MI-194	Transparent Blue
MI-195	Transparent Yellow •
MI-198	Transparent Yellow-Shade Red
MI-1186	Light LED Red

**\*All transparent colors have limited intercoat adhesion. • May not be suitable for lightfast applications and is not recommended for prolonged exposure to direct sunlight.**

## Metallic Pastes

040	Gold Paste	042	Silver Paste
044	Red- Gold Paste	046	Copper Paste

## Special Metallic Silver

S3100	Silver Metallic
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## Metallic Powder

038	Silver Powder
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### Custom Powder/Pigment Additives:

Customers may wish to use a special powder or pigment additive not produced by Norcote®. The use of any powder or pigment additive should be discussed with a Technical Service Representative prior to use to determine material compatibility.

### MI-000 and MI-049:

The MI-000 is ideal for use as a base for mixing metallic pastes. The MI-000 should be kept covered when not in use and is not recommended for use as an overprint clear. The MI-049 should be used as an overprint clear or protective layer.

### Ink Thinning:

The use of additives to thin the ink is not recommended. The 049 Clear may be used to thin the ink.

### Additives:

Check the Norcote Additives list for the products compatible with this ink series. The list is available on our website at [www.norcote.com](http://www.norcote.com) or call us at 800-488-9180 to receive a copy.

### Packaging:

The MI Series is available in quart, gallon, 3 gallon, 5 gallon, and kilogram unit containers. Product samples are available in 8 and 16 ounce quantities, if requested. Contact Customer Service for pricing and additional packaging requests. Metallic pastes are available by the pound.

### Hazardous Materials Statement:

The MI Series does contain N-Vinyl-2-Pyrrolidone (NVP). For additional information regarding Industry Compliance Standards, please contact Technical Service.

We recommend testing of the ink system in each production process to verify suitability for use prior to the start of a production run. This includes verification of ink performance in the printing, forming, trimming and injection molding processes as well as post-production testing (ELT/ALT).

### Storage & Available Warranties

All UV MI Series inks should be stored in tightly closed, black polyethylene containers in an area with the temperature not to exceed 90° F (32.2° C). Avoid direct sunlight and indirect white light. Excess ink from print runs should be stored in separate containers to avoid contamination and is not covered under any warranty.

When stored under these conditions, Norcote warrants the Products shall be free from defects in material and manufacture for a period of one (1) year from the date of sale for the MI Series standard inks, with no additives, and for a period of one (1) month from the date of sale for any custom color containing Day Glo® JZB. **Norcote will not warrant any custom colors containing metallic pastes or any inks intermixed with competitor products.** Any warranties provided will be limited to the price paid for the actual products used which give rise to the warranty claim.

This Technical Bulletin is intended to be used for informational purposes only, and is in no way intended to create any warranties or other obligations on behalf of Norcote. All warranties, terms and/or conditions for a particular product will be specified on the applicable invoice and are only valid upon the creation of a legally-binding contract.

### Testing

Due to the inability of Norcote to anticipate or control the conditions under which the Products and information relating thereto will be used and/or stored, Norcote cannot guarantee the results obtained from using the Products. Any Suggested Uses are merely representative, and because the final product will depend on a number of specific factors, the end user should pretest all substrates with the Products prior to use in production.

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