



NORIPHAN® HTR N

Ink System for Second Surface IMD/FIM Technology
(back molding of screen printed films)

Area of Application

NORIPHAN® HTR N is a solvent-based one-component screen printing ink based on a high temperature resistant thermoplastic resin.

Characteristics

Films printed with NORIPHAN® HTR N are perfectly suited to the IMD/FIM process (In-Mold-Decoration/Film Insert Molding):

- **formability**
- **temperature and washout resistance during injection molding**
- **good permanent bonding with injection molding resins, preferably PC**

Equipment for Printing on Films within IMD/FIM Technology

- **Tunnel dryer, with final active cooling**
 - **3 heating sections with 80 °C (175 °F) minimum and high air exchange rate**
 - **active cooling adjustable to 15 °C (60 °F)**
- **Box oven adjustable up to 90 °C (195 °F)**
- **Racks for single placing of printed sheets**

**Different supplier of IMD/FIM parts utilize different equipment for production which requires individual adjustments of process parameters.
For this reason production parameters of the same IMD/FIM parts at different supplier can be very different for best results from each origin.**

Films

PC film: Makrofol®¹

PC blend film: Bayfol®¹

Finish

Glossy

The gloss level is influenced by the structure of the substrate.

Color Shades

Halogen Free	108 Citron HF	471 Violet Transparent HF
Basic Colors	112 Yellow HF	(not available in the USA)
	225 Orange HF	566 Blue Transparent HF
<i>HF = halogen free</i>	318 Red Transparent HF	570 Deep Blue HF
	321 Bright Red HF	665 Green HF
	372 Bright Red Transparent HF	945 White HF
	412 Pink Transparent HF	952 Black HF
	445 Violet HF	093 Colorless HF

¹ Makrofol® and Bayfol® are registered trade marks used by Covestro AG, Germany

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Basic Colors	109 Citron	320 Bright Red
(containing halogens)	171 Yellow Transparent	472 Violet
	213 Orange	669 Green Transparent
	(not available in the USA)	812 Brown
	308 Red	

For even greater temperature resistance (better resistance to washout), our basic colors are also available with the designation /050 (e.g. NORIPHAN® HTR N 952/050 is high temperature resistant Black). It should be noted, however, that the formability of versions /050 may be somewhat reduced and printed films have a tendency to curling.

Halogen Free	770 Silver HF	943 Blending White HF
Special Colors	782 Silver Coarse HF	944 White Opaque HF
	790 Silver Glossy HF	953 Deep Black HF
	(press-ready)	

Special Color 371/001 Red Transparent
(containing halogens)

Silver inks may be used to mix gold and other metallic colors.

Effect Pigment Colors

Further metallic, color-flop, pearl effect, fluorescent and other colors are available on request.

Caution:

The peel strength (bonding) of the silver and effect inks is lower than that of the basic colors. Back molding the special effect colors may alter the orientation of the pigment particles.

Mixed Color Shades

Transparent mixed colors with a small proportion of NORIPHAN® HTR N 945 White may exhibit coverage issues.

This can be corrected by adding NORIPHAN® HTR N 943 Blending White. NORIPHAN® HTR N 943 should, however, be tested under the respective printing conditions (type of thinner, proportion of thinner, printing speed, etc.).

Halftone Inks

IMD/FIM halftone inks are available with the designation **NORIPHAN® PCI N**. Additional information is given in a separate Technical Information bulletin.

Mesh Count

Polyester mesh 77-48 threads/cm to 150-31 threads/cm (195-48 threads/inch to 380-31 threads/inch). A stainless steel mesh may be used for special requirements.

The following mesh counts are recommended for standard silver:

NORIPHAN® HTR N 770 – 120-34 threads/cm (305-34 threads/inch) or coarser

NORIPHAN® HTR N 782 – 77-48 threads/cm (195-48 threads/inch) or coarser

NORIPHAN® HTR N 790 – 100-40 threads/cm (255-40 threads/inch) or coarser

Stencil

Solvent resistant emulsions must be used. Excellent results during long production runs are achieved by using Pröll Diazo-UV-Polymer Emulsion Norikop 10 HQ.

Auxiliaries

All of the auxiliaries mentioned below are free of halogens (HF).

Thinner

Thinner F 013 (fast)

Thinner M 201 (medium)

Thinner S 403 (slow)

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Retarder Pastes

NORIPHAN® HTR N 097/005 (fast)
NORIPHAN® HTR N 097/006 (medium)
NORIPHAN® HTR N 097/007 (slow)

Auxiliaries may be mixed with each other in any desired proportions.

Only Thinner F 013 and Thinner M 201 should be used for large printing areas.

Recommended addition of thinner: 15 – 20 %.

To print fine details, Thinner S 403 can be used alone or in combination with retarder pastes NORIPHAN® HTR N 097/005, 097/006 respectively 097/007.

The following proportions are recommended:

10 – 20 % Thinner S 403
5 – 10 % NORIPHAN® HTR N 097/007

NORIPHAN® HTR N 097/008: Retarder Paste ready to use mixture of Thinner S 403 and Retarder Paste NORIPHAN® HTR N 097/007 (mixing ratio 1 : 1)

Matting Agent

NORIPHAN® HTR N Matt Paste 098
Addition: approx. 20 %

Elastificator

NORIPHAN® HTR N 061 to improve formability of ink layer.
Addition: approx. 5 %

Antistatic-Additive

NORILIN® C to prevent static charging, especially when printing metallic inks.
Addition: 0.5 %

Defoamer

Defoamer 5702 to prevent any possible flaws in color gradient (craters, bubbles). Adding too much Defoamer 5702 causes white spots.
Addition: max. 0.5 %

Cleaning of Screens and Utensils

UNI-REIN A III

Drying

NORIPHAN® HTR N is a physically curing ink system which dries through evaporation of the solvent in a tunnel dryer.

Note:

To protect PC films from extensive solvent attack, tunnel dryers should be used also for small trial runs. Rack drying is not recommended (cracking!).

Tips on Drying

Drying performance can be improved by:

- drying at higher temperatures
- use of infrared rays (from second heating compartment on)
- completely opened exhaust air valve – good air exchange.

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The following settings are recommended for use with 3 zone dryers:

- First Zone: 80 °C (175 °F).
- Second Zone:
In the second zone, the maximum temperature for processing heat sensitive Bayfol® films is 80 °C (175 °F).
The maximum drying temperature for processing pure PC films (Makrofol®) is 100 °C (210 °F). If additional infrared emitters have been installed in the second compartment, they may be used to increase the efficiency of the drying operation.
- Third Zone: For cooling down to ambient temperature.

Drying results depend on the combination of thinner and retarder paste along with the thickness of the ink layer.

Conditioning / Post-curing

Complete evaporation of solvent residues in ink and film is necessary for further processing of printed films in the IMD/FIM process.

Thinner residues can lead to washout during the back molding process, or damage during the climatic test or use of the end product.

Fully benefiting from NORIPHAN® HTR N's superior properties (adhesion, suitability for back molding, etc.) requires guaranteeing an absolute minimum of solvent residues.

Post-curing is done after printing the last ink layer; the ideal conditions for each product must be determined individually.

For best results, dry separately on a rack in a well ventilated box oven with air exchange.

Conditions:

Post-curing at 75 – 90 °C (165 – 195 °F) for 1 – 5 hours.

Maximum temperature 70 – 80 °C (160 – 175 °F) for processing heat sensitive films of PC blends such as Bayfol® CR.

In case of an application of too high temperatures with Bayfol® CR a change into bluish coloring of the film could be observed.

Bonding Strength

The adhesion of a film/ink/plastic bonding system depends on a number of variables (production, process, and structure of compound). For this reason, specific tests with respect to individual requirements are essential.

Safety Precautions

NORIPHAN® HTR N inks are inflammable. Smoking or open flames are strictly prohibited during use of these products.

Processing NORIPHAN® HTR N inks requires normal hygiene in the workplace.

Please see recommendations on label and read the material safety data sheets before use.

Shelf Life

The shelf life stated on the label assures the ink's quality and refers to unopened original cans stored in a dry place at temperatures between 5 °C (40 °F) and 25 °C (75 °F).

Important

Allow the ink as well as all the auxiliaries to be added to adjust to room temperature in the closed container before use.

Printing results, to a large extent, depend on the substrate as well as the printing and application conditions. We recommend checking your printing materials under your conditions of use prior to any production runs. Materials that are supposed to be identical may vary from manufacturer to manufacturer and even from batch to batch. Some substrates may have been treated with or can contain sliding agents, antistatics or other additives which will impair the adhesion of the inks.

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It is not always possible to produce a given part using IMD/FIM technology.

The resins used for back molding IMD/FIM ink systems are supplied as commercial technical products. They are different in chemical composition as well as the content of additives. Process parameters will also influence the quality of the finished IMD/FIM parts.

Before starting a production run, it is necessary to test samples of each newly designed part systematically with regard to the specifications for the intended use (e.g. climatic chamber, resistance, etc.).

Recommendations for use of **NORIPHAN® HTR N** in IMD/FIM Technology

Important Note

This special ink system has been verified in production for many years as a proven solution. No adverse reports on the stability of the product or problems with adhesion/delamination have been received. Due to the great number of factors influencing the use of NORIPHAN® HTR N for IMD/FIM Technology, no guarantees regarding the applicability of the system can be made.

IMD/FIM Technology

IMD/FIM technology is distinguished by the interaction of several individual technologies:

- ink and printing
- cutting/punching
- forming
- back molding

The steps of the process must be optimized individually, then aligned with each other.

The NORIPHAN® HTR N Ink System

NORIPHAN® HTR N is a solvent-based screen printing ink system expressly developed for use in the IMD/FIM process. It is particularly suited to printing polycarbonate films such as Makrofol® or PC blend films such as Bayfol® to be back molded, particularly with polycarbonate.

Each batch of NORIPHAN® HTR N undergoes a specific quality control test. Analytical data can be made available to customers upon request. This does not constitute a guarantee regarding the long-term stability of back molded parts produced with NORIPHAN® HTR N.

Forming

The result of the forming process is strongly influenced not only by the choice of the forming technology, such as high pressure or vacuum, but the geometry of the parts produced as well. Forming requires specific know-how gained through experience.

Back Molding

A complex technology which **in any case** must be mastered to assure the successful application of NORIPHAN® HTR N in IMD/FIM technology. Specific know-how of the following parameters:

- geometry of injection gate
- pressure
- temperature of molding resin
- cycle time
- choice of resin
- tool cooling
- flow properties of resin

are pre-requisite or must be gained through experience.

Here, the geometry of the parts to be produced is also of critical significance.

The information contained in the technical information/instruction sheets or other product information sheets is based on product testing conducted by Pröll. Because printing and environmental factors critically affect each individual ink application, the above mentioned information and instructions represent only general recommendations concerning product characteristics and directions for use and should not be construed as representing express warranties regarding the product. The information and instructions in no way release the purchaser from his obligation to verify and test the inks and their application for the specific request, regarding: product characteristics, weather resistance, mixing proportions, gloss, thinning, special mixtures, printability, drying speed, cleaning, effects on or of other materials to be contacted and safety precautions. All details contained in the instruction sheet "General Information on Screen Printing Inks" are to be considered. The further manufacture and use of products containing our inks by the purchaser takes place beyond our control, and the responsibility for further application and use of our product resides solely with the purchaser. Pröll disclaims any warranties, express or implied.

This information supersedes all previous technical information.

Guidelines for Use of **NORIPHAN® HTR N**

- Problems and Solutions

Problem	Solutions / Recommendations
1. Printing	
<i>Inadequate screen open time</i>	<ul style="list-style-type: none"> • Verify that thinning was done according to instructions. • Use Thinner M 201 or Thinner S 403; add more thinner. • Use Retarder Paste NORIPHAN® HTR N 097/007 in combination with Thinner S 403 (check blocking resistance carefully). • Optimize mesh: fine threads with greater mesh opening are better than standard qualities.
<i>Poor flow</i>	<ul style="list-style-type: none"> • Films contaminated? – Clean material and equipment. • Adjust machine settings: speed, hardness, angle, pressure of squeegee. • Use finer mesh. • Variation of thinner addition. • Recheck addition (quantity) of Defoamer 5702. • Recheck transparent white color shades containing Blending White NORIPHAN® HTR N 943.
<i>Cratering / Pinholing</i>	<ul style="list-style-type: none"> • Check printing viscosity – try increasing and decreasing. • Check if mesh or auxiliaries are contaminated with silicone residue. Use only silicone free materials. • Check quality of films.
2. Forming	
<i>Cracks during forming process</i>	<ul style="list-style-type: none"> • Thicken ink layer by increasing number of prints or using coarser mesh (77 – 90 threads/cm, 195 – 230 threads/inch). • Verify if cracking occurs prior to forming process. If not, it can be stress cracking which can be avoided by a quicker transfer into the drying section. Use tunnel dryer, no rack drying. • Check forming process and equipment. High Pressure Forming of company Niebling GmbH is recommended. • Overprinting of the ink layers with transparent lacquer NORIPHAN® HTR N 093. • Addition of Elasticator NORIPHAN® HTR N 061 to the printing ink (Caution: the washout resistance will be reduced; please check the back molding results).

Problem	Solutions / Recommendations
3. Back Molding	
<i>Washout</i>	<p>Utmost priority: molding parameters! NORIPHAN® HTR N is resistant to high temperatures, but sensitive to additional high shear forces – <u>indirect molding is recommended</u> – contact <u>Covestro AG</u>.</p> <p><u>Recommended actions:</u></p> <p><i>Injection molding</i></p> <ul style="list-style-type: none"> • Modify gating layout • Reduce viscosity of the thermoplastic resin by: <ol style="list-style-type: none"> 1) <u>increasing</u> temperature of molding resin. 2) using “high-flow” types. • Improve thermal flow: <ol style="list-style-type: none"> 1) increased cooling of film insert side of the tool 2) use thinner films when applicable. <p><i>Ink</i></p> <ul style="list-style-type: none"> • Check curing of ink layer: initiate/prolong post-curing operation or raise drying temperature. • Test NORIPHAN® HTR N types (e.g. NORIPHAN® HTR N 952/050 or 945/050) with increased temperature resistance. • Silver Inks: overprint with white, clear lacquer or other colors free of metallic pigments to protect the metal particles.
<i>Faulty Bonding</i>	<p>⇒ If all improvements are realized, a changeover to NORIPHAN® XMR or NORIPHAN® XWR in combination with NORIPHAN® HTR N should be tested.</p> <ul style="list-style-type: none"> • Vary molding parameters – e.g. temperature of resin, molding pressure and injection speed – contact <u>Covestro AG (Film Group)</u>. • Use adhesion promoter, e.g. AquaPress® CA LT and HT or NoriPress® SMK. The effect when used with silver inks is limited, however. • Mix inks to be used for larger areas with 15 – 50 % NORIPHAN® HTR N 093. <p>⇒ If all improvements are realized, a changeover to NORIPHAN® XMR or NORIPHAN® XWR in combination with NORIPHAN® HTR N should be tested.</p>