



Cyrel®
flexographic printing plates

*DuPont Processing Manual
for Cyrel®*





PREFACE

Dear Cyrel® User

DuPont Cyrel® is the leading manufacturer and an experienced partner of the flexographic industry.

It is our philosophy to offer you modern products, innovative solutions, comprehensive support, and an applications technology service that will help you increase your quality and productivity.

Flexographic printing has developed from a simple technology to a competitive printing procedure. But even today, new developments and technologies are still continuously changing and influencing this procedure, and they always constitute something of a challenge.

The DuPont Processing Manual for Cyrel® contains practical instructions for the production of Cyrel® printing plates. The manual provides the user with information on the proper processing of Cyrel® printing plates and on the various components that make up the Cyrel® system. It describes the different plate types and their areas of application and provides guidelines for the environmentally and operationally safe handling of Cyrel® plates, wash-out solutions, and the production procedure.

A processing manual cannot cover every single detail that may possibly be relevant at some time or another in the course of day-to-day practice. Nonetheless we have made every effort to describe the individual processing stages in as much detail as possible.

Should you have any further technical questions to which this DuPont Processing Manual for Cyrel® has not provided an answer, a qualified team in DuPont's Customer Technology Center in Neu-Isenburg will be happy to provide information and assistance.

You can contact us under telephone number (49) 61 02 – 18 39 31 or fax number (49) 61 02 – 18 39 68.

A handwritten signature in black ink, appearing to read 'Friedrich Wolf', with a long horizontal stroke extending to the right.

Friedrich Wolf

Manager Cyrel® Applications Technology



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Introduction

The Cyrel® system is a procedure designed for the quick and simple production of printing plates for flexographic printing. It operates on the basis of resilient photopolymer plastics, which feature a number of technical and economical advantages:

- 1. The procedure involves few processing stages and is easy to learn.*
- 2. The results are reproducible.*
- 3. The procedure is equally suitable for line, halftone, and combination work.*
- 4. High resolution, dimensional stability, and register accuracy have made Cyrel® the preferred plate material used for printing high-quality flexo work.*

As is the case in all multiple-colour work, the separations and film negatives must comply with the printing conditions prevailing from case to case.

A computer programme designed for recording the relevant print characteristics and incorporating them in the production of the corresponding colour separations is available from DuPont under the name CyFOS.





Chapter 1
*Safety, Environmental Protection,
and Work Hygiene*



SAFETY, ENVIRONMENTAL PROTECTION, AND WORK HYGIENE**CHAPTER 1**

1.1

GENERAL

If handled properly, the processing of Cyrel® photopolymer flexo printing plates is neither hazardous nor detrimental to human health.

However, in the event of careless operation, irregular handling, and neglecting normal safety measures, hazards cannot be entirely excluded.

The following recommendations are provided to ensure safe handling and your personal protection.

Safety Regulations of the Chemical Industry

When handling chemicals, the general safety regulations of the chemical industry are recommended, which should always be observed.



Note:

- *Please refrain from eating, drinking, and smoking in the work area.*
- *When handling wash-out solutions, please wear protective goggles and rubber gloves.*

The operating staff must be carefully instructed on the properties of the chemicals used and the potential hazards involved if they are not handled with proper care. The operating staff must be made familiar with the proper installation, handling, and maintenance of the equipment. All staff must be alerted to potentially hazardous situations and trained in the resulting relevant procedures and remedies.

CYREL® RAW PLATES

1.2

Prior to exposure, Cyrel® raw plates contain chemicals which in sensitive people may cause allergies or skin irritations. During handling, the polyester backing and the cover sheet offer an effective protection. After removing the cover sheet, an extremely thin separation layer remains on the plate surface, which largely prevents any direct contact with the monomers deposited in the plate. The risk of skin irritations is therefore relatively low.

Nonetheless we recommend not to use the cover sheet, once removed, for other purposes, e. g. as a mounting film.

After processing, the relief plates can be further handled without the risk of irritations.

PROCESSING EQUIPMENT

1.3

The processing equipment is designed to exclude hazards when handled with proper care.

As a rule, the following applies:

- *In the event of necessary maintenance work, switch off and secure the master switch or disconnect the mains plug. This also applies for the replacement of tubes or lamps.*
- *When replacing lamps, use protective gloves (risk of fracturing).*





1.3.1

Exposure Units

The tube lamps used for exposure are fluorescent UV lamps.

UV output is primarily in the UV-A range (wave length 350 – 400 nm), though limited emissions in the UV-B range cannot be entirely excluded.

While light scatter during exposure can be regarded as harmless, direct exposure of the eyes to UV rays when the exposure unit is open should be avoided.

If necessary, wear suitable protective goggles.

1.3.2

Processors and Dryers

Cyrel® plates are washed out using a wash-out mixture. Improper handling may entail damage to human health and the environment.

i *(Please also refer to Section 1.4 "Wash-Out Solutions".)*

It is imperative to ensure a thorough ventilation of the working environment and a continuous sufficient fresh air supply.

i *(For detailed instructions, please refer to the Unit and Installation Manual.)*

The processors and dryers are designed to ensure that the operator virtually does not come in contact with the wash-out solution. A partial vacuum in the equipment prevents fumes from escaping.

The fumes can be emitted into the open air or into an in-house waste air system, provided the regulations specified by the technical regulations for waste air are duly observed.

(For additional information on this subject, please contact DuPont field service).

Equipment that needs to be opened in order to insert and remove the plates is subject to the following precautions:

- *Handle the plates only when wearing suitable protective gloves and goggles. Avoid inhaling the fumes wherever possible. Keep the washer unit closed, only open when necessary.*

Finishing Equipment

Finishing is effected using UV-C light (254 nm wave length). The tube lamps are mounted in a combination unit which is also equipped with UV-A tube lamps for final exposure.

- *When operating at the open unit, be sure to protect your eyes against direct and indirect UVC radiation! Even exposure over brief periods may cause damage.*
- *When replacing the tube lamps, be sure to wear protective gloves.*

The units are equipped with special protective devices. Maintenance work should be performed by qualified engineers only.

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1.3.3



1.4

WASH-OUT SOLUTIONS

DuPont offers the alternative wash-out solutions OptiSol®-737, FlexoSol®, and UniSol®. Unlike previously used wash-out solutions, these products do not contain any chlorinated hydrocarbons.

Alternative Wash-Out Solutions

OptiSol® 737

- *Consists of a mixture of isoheptyl acetate and isoheptyl alcohol.*

FlexoSol®/UniSol®

- *Consists of a hydrocarbon/alcohol mixture.*

Alternative DuPont wash-out solutions are free of halogenated and fluorinated hydrocarbons. Nonetheless the usual precautions recommended for handling solvents should be observed.

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(For detailed information, please refer to the relevant brochure.)

1.5

HEALTH PROTECTION

Wash-out solutions have a degreasing effect on the skin. If direct contact cannot be avoided, please wear solvent-resistant protective gloves (not household gloves) and protective goggles.

Should splashes of the solution come in contact with the eyes, immediately rinse with water for approximately 15 minutes and, if necessary, consult a physician.

Immediately remove clothing soiled with wash-out solution and wash the affected skin areas with a mild soap.

When wearing protective gloves over longer periods of time, the hands tend to perspire and become humid, especially in warm weather. We therefore recommend to clean your hands from time to time using an antiseptic hand wash and afterwards wash them with soap and water. After washing, apply an anhydrous hand lotion containing lanolin.

Although the alternative wash-out solutions developed by DuPont largely exclude any direct hazard to personal health, they should be handled with the due care generally required when handling chemicals.

(For special information and recommendations with a view to environmental protection please refer to the relevant user brochures.)

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Chapter 2
The Cyrel® Plate System



**THE CYREL® PLATE SYSTEM****CHAPTER 2****2.1 COMPONENTS****2.1.1 Safety and Environmental Protection**

Cyrel® plate types are manufactured in all thicknesses required for flexographic printing and in all sizes tuned to the special requirements of the market. A targeted development philosophy and the constant adjustment of the material to changing requirements ensures that an optimised Cyrel® printing plate is available for virtually every conceivable area of application.

2.1.1.1 Responsibility of Cyrel® Management

Product support – the safe manufacture and use of Cyrel® while at the same time ensuring minimum impact on the environment today or in the future – is one of the main pillars of the Cyrel® business and equally as important as safety, innovation, and quality of products and services.

2.1.1.2 Cyrel® Sales and Technical Support

The sales and technical support service gives each Cyrel® customer access to the knowledge and experience of the global DuPont organisation with a view to work safety and protection of personal health and the environment. In this area, DuPont is an acknowledged industry leader, offering a safety standard that is more than 50 times higher than the industry average (according to trade association regulations). Direct communication with repro houses and

the quick exchange of information in both directions are the key not only to maximum benefit, but also to the recognition and consistent prevention of hazards and risks for humans and the environment.

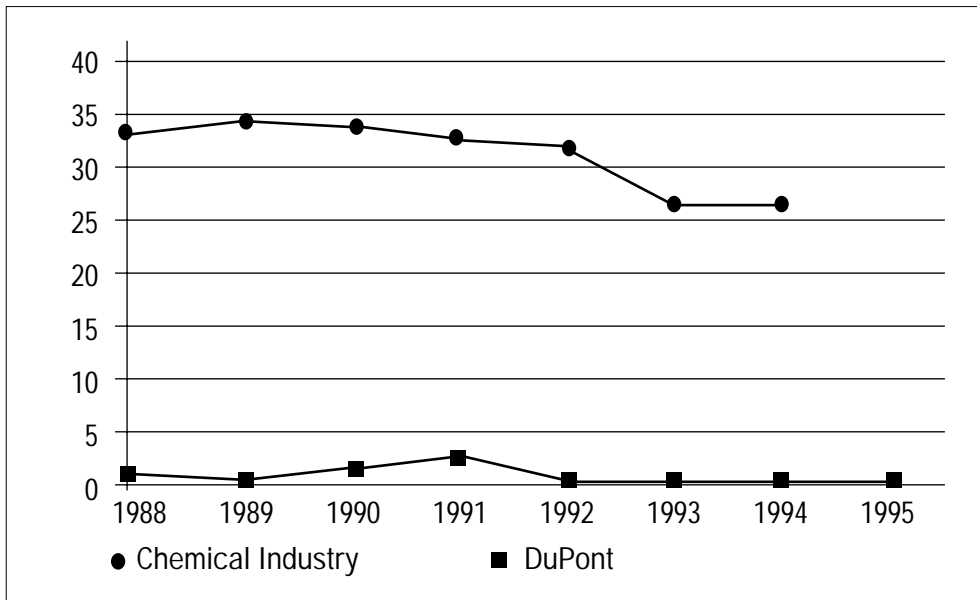


Fig. 1: Reported work accidents per 1000 employees, BG System

Cyrel® Flexo Printing Plates

2.1.1.3

Cyrel® flexo printing plates do not bleed, nor can they be spilled. Direct contact with the polymer, which is embedded between a polyester backing and a protective sheet, or the release of substances from the plate to the environment are safely excluded. This protection is effective throughout all distribution and processing procedures. Product safety and protection of the environment are thus an integral part of Cyrel® printing plates and do not need to be ensured by complex measures, the implementation of which is difficult to monitor. Therefore, Cyrel® flexo printing plates are not considered toxic materials as defined in the regulations on hazardous substances.

2.1.1.4 Composition of Cyrel® Printing Plates

Cyrel® printing plates are manufactured from carefully tested raw materials that do not contain any bio-accumulative components. As a rule, we keep a close eye on developments in toxicology and the development of statutory provisions, enabling us to adjust our research activities accordingly the very instance a new hazard becomes apparent. We support all efforts to ensure that future generations will not have to bear the consequences of today's Cyrel® printing plates.

2.1.1.5 Cyrel® Plate Manufacturing

The clear and unambiguous requirements are: No waste and no toxic emissions.

Cyrel® printing plates are manufactured in an energy-conserving and solvent-free manufacturing process reflecting the current state of the art. This process produces negligible emissions into the air and no water pollution load, and has therefore been operating without problems for many years in the immediate neighbourhood of the residential population of Neu-Isenburg. The continuous improvement of internal procedures and supplies over the past few years, including the reduction and recycling of transport materials and residual substances, was not only a wise decision from an economical point of view, but has also enabled us to establish a largely waste-free production environment, with the aim of achieving a completely waste-free production in the near future.

Cyrel® Packaging

2.1.1.6

Cyrel® printing plates can be supplied in re-usable wooden crates. Apart from preventing unnecessary packaging waste, this packaging method also ensures excellent protection of the fragile printing plates during transport and storage. The corrugated board packaging used for the remaining deliveries can be easily recycled. Naturally, we offer our customers the possibility of returning these materials to us for reuse or recycling, to ensure that they are not deposited in the waste cycle.

Cyrel® Processing Equipment

2.1.1.7

We offer our customers a complete line of Cyrel® processing equipment, including devices for distilling and recirculating wash-out solutions. These devices are manufactured with the same care, quality, and inherent safety as Cyrel® printing plates and consumables. The normally closed design protects the operators against potential hazards, e.g. intense UV radiation, wash-out solutions, or mechanical injury during cutting or punching procedures. With Cyrel® processing equipment, our customers can confidently rely on our having made every effort to manufacture flexo printing plates safely and in high quality.

Cyrel® FlexoSol® and OptiSol® Wash-Out Solutions

2.1.1.8

Especially in combination with the closed Cyrel® processing units and the Cyrel® wash-out solution recirculation units, FlexoSol® and OptiSol® offer plate processing in prime quality while at the same time ensuring maximum safety and environmental protection.



2.1.1.9 Cyrel® ISO 9001 Certification

Cyrel® was awarded ISO 9001 certification in 1992, which was renewed again in 1995. This certification encompasses all aspects of the Cyrel® operation, from design to production and distribution through to the application of our products at the customer's installation. Its purpose is to inspire confidence in the ability to meet all requirements with respect to quality, safety, and protection of the environment.

2.1.1.10 Cyrel® – An Entire Life Cycle Without Waste

Since the end of 1995, we have offered our customers in Europe the possibility of returning used Cyrel® printing plates to us, and since the end of 1996, the same applies to distillation residues from Cyrel® processing procedures on the basis of FlexoSol®, OptiSol® and UniSol®. These products are reliably recycled by qualified industrial partners.

This is the last step in our Cyrel® product care philosophy, and it once again illustrates our commitment to Cyrel®. This commitment does not end at the factory gates, but comprises all aspects of our business, including our customers. We are proud of what we have accomplished and will build on our achievements to further reinforce the foundations of our business.

2.1.2 The Processing Equipment

The raw materials are processed in six steps requiring four different devices:

1. *Exposure unit for back and main exposure.*
2. *Wash-out unit (processor).*
3. *Drier.*
4. *Post-processing and final exposure unit.*

The processing units are available in different versions:

1. Separate drier and finishing unit.

- *The 1002 system for plate sizes up to 90 x 120 cm = 36 x 48 inches.*
- *The 2001 system for plate sizes up to 107 x 152 cm = 42 x 60 inches.*
- *The 3002 system for plate sizes up to 127 x 203 cm = 50 x 80 inches.*

Fully automatic 3002i system with integrated drier and finishing unit up to a plate size of 127 x 203 cm = 50 x 80 inches.

Know-How and User Software

2.1.3

DuPont has more than twenty years' experience in flexographic printing and is engaged in extensive research and application technology. The Customer Technology Centre (CTC) is also available for the training of your employees, offering programmes for training, quality control, setting up printing parameters, and the necessary software. This know-how is at your disposal. Please contact the Cyrel field service for more information.

CYREL® PLATE STRUCTURE

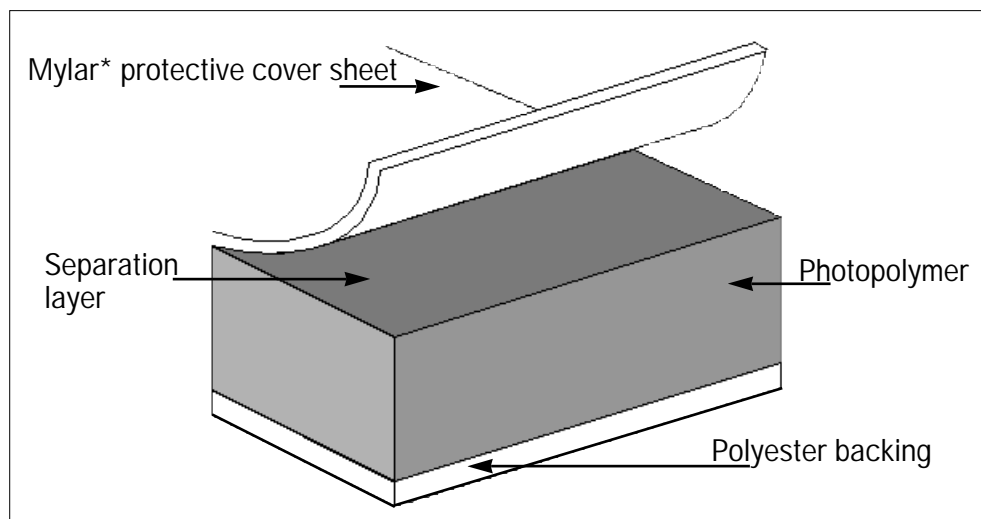


Fig. 2: Cyrel® raw plate

The procedure is based on a polymerisation process which is initiated by exposure to short-wave UV radiation.

The Cyrel® raw material is a flexible plate consisting of three layers. An elastomer bonding agent, in which unsaturated monomer compounds and UV-sensitive initiator substances (receptors) are embedded, is applied to a dimensionally stable polyester backing. A protective cover sheet made of Mylar® protects the plate against mechanical damage and the influence of oxygen. The plate is sensitive to heat, daylight, UV radiation, and short-wave artificial light. It can be handled under UV-free safelight conditions.

When the raw plate is exposed using UV radiation, the initiator molecules are split into radicals. These radicals attach themselves to a monomer molecule to form a new radical. Several of these radicals grow together, creating chain molecules which in turn are cross-linked to obtain a molecular network.

This polymerisation process causes the original physical properties of the raw materials to be modified in such a way that the bonding agent is no longer soluble in certain solvents. At the same time, the plate remains resilient and flexible.

If the film copy used is a negative, a positive relief image is obtained on the plate. Image development begins at the plate surface and moves conically downwards. The image elements have sharply defined edges and a conical base, ensuring sufficient stability during the printing procedure.

The exposure is followed by a wash-out procedure during which the non-polymerised structures in the plate are removed. The surface of the remaining relief is identical in minute detail with the transparent areas of the original negative.

In the subsequent drying process, the solvent absorbed by the plate during the wash-out procedure evaporates. The plate resumes its correct original thickness.

The plate's final stability, durability, and surface structure are obtained by finishing and final exposure.

THE CYREL® RANGE OF PRINTING PLATES

2.3

Extensive research and a continuous adjustment to changing market requirements have made it possible to offer the user a suitable Cyrel® printing plate for every conceivable area of application in flexo.

The Cyrel® range of printing plates can be subdivided into three main areas:

1. *Plates for printing flexible packaging (film and smooth paper qualities).*
2. *Plates for printing board, corrugated board, and substrates with coarse surface structures.*
3. *Plates for varnishing offset printing products.*

The plates are designed for printing with standard alcohol or water-based flexo inks. UV-drying inks and varnishes may also be used. They are not compatible, however, with oil-based inks and aggressive solvents such as acetates or ketones.

2.3.1 Standard Printing Plates

2.3.1.1 Single-Layer Plates

Cyrel® HCS – HOS – HOF – UXL

The areas of application of these plate types are:

- Flexible packaging/film
- Paper
- Beverage cartons
- Carrier bags
- Labels
- Pre-printed corrugated board

Plates with PQ Layer

2.3.1.2

Cyrel® PLS – POF – EXL – UVP

On account of its excellent ink transfer and printing properties, PQ material is used primarily for high-quality work on flexible materials.

The main areas of application are:

- Flexible packaging/film
- Paper
- Beverage cartons
- Carrier bags
- Folding boxes
- Labels
- Pre-printed corrugated board

Thin Plates

2.3.2

Cyrel® PLB – HOFB – POFB

By using thin plates (plate thicknesses from 0.76 to 1.14 mm) a high standard of quality can be achieved in flexo printing.

The main areas of application of these plates are:

- Flexible packaging/film
- Beverage cartons
- Carrier bags
- Labels
- Pre-printed corrugated board

2.3.3 Deep-Relief Plates

Cyrel® TDR

This plate type is used primarily for substrates with a coarse surface structure (board, corrugated board). For this area of application, the plates must have a low Shore hardness while at the same time offering high flexibility to ensure a better adjustment to the coarse surface and flawless printing of solids.

2.3.4 UV Flexo Printing

Cyrel® UVP

This printing plate was developed especially for printing with UV-curing inks. However it provides also outstanding printing results with with solvent- and water based inks.

Its areas of application are:

- Flexible packaging/film
- Beverage cartons
- Carrier bags
- Labels
- Folding boxes
- Pre-printed corrugated board

Offset Varnishing

2.3.5

Cyrel® CL-CLAM

The Cyrel® CL varnishing plate is a flexible letterpress plate designed for high-quality converting in offset presses.

It is used for full-surface and spot varnishing (CL) and for printing with metallic pigments in inking units specifically designed for this purpose (CLAM).

Cyrel® Digital Imaging Plates

2.3.6

Cyrel® DPS – DPH – DPU

The surface of these plates is equipped with a laser-sensitive layer allowing for the filmless transfer of the image data onto the plate.

Imaging is effected directly from the digital data stored in the Cyrel® Digital Imager.

This direct filmless image transfer allows for maximum resolution.

In addition, the plates produce very steep side walls and extremely low dot gain.

Cyrel® Digital Imager plates are used in all areas of application requiring maximum standards of quality.

2.4

PLATE THICKNESS – RELIEF DEPTHS

Cyrel® raw material is supplied in various thicknesses and sizes to suit the different plate cylinder undercuts of the different presses.

Thin plates are used for high-quality halftone flexo printing, while the thicker plates with a deeper relief are used to print corrugated board.

The formulation of the photopolymer layer is identical within individual plate types, with the layer differing only in terms of thickness. The relief depth is variable.

In the case of thin plates (up to 1.14 mm) the thickness of the backing is 0.18 mm (CL plates 0.25 mm), for all other plates it is 0.13 mm.

The type designation of the plates is derived from the overall thickness including the backing minus the thickness of the protective sheet. The value is indicated in thousandth of an inch (0.1 inch = 2.54 mm).

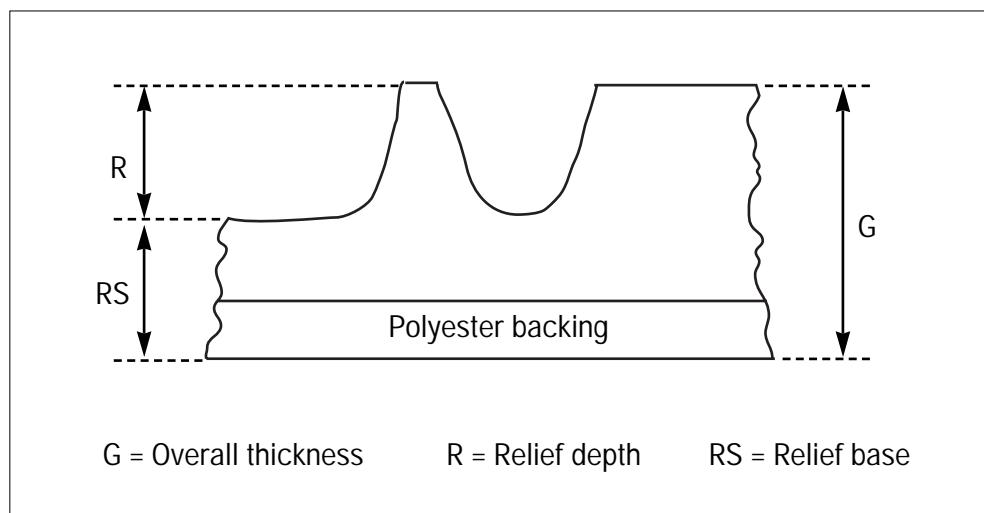


Fig. 3: Cross-section of a Cyrel® relief plate

The following table lists the available thicknesses and the recommended relief depth.

(For packaging and sizes, please refer to your price list.)

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Cyrel® Range of Products – Plate Thicknesses – Relief Depths

Plate Type	Plate Thickness	Recomm. max. Relief Depth
0.001 inch	mm	mm
30	0.76	0.58
45	1.14	0.75
67	1.70	1.0
90	2.29	1.0
100	2.54	1.0
107	2.72	1.0
112	2.84	1.0
125	3.18	1.0
155	3.94	1.8
170	4.32	2.0
185	4.70	2.3
197	5.00	2.5
217	5.51	2.5
237	6.02	3.0
250	6.35	3.0
255	6.50	3.0

2.5

MEASURING PLATE THICKNESS AND HARDNESS

Cyrel® printing plates are carefully manufactured and checked to tight tolerances.

During processing, however, they are subjected to influences that may considerably affect the plate's ability to resume its original thickness.



Therefore, it is imperative that the processing parameters recommended by us be observed:

- *Sufficient exposure.*
- *Correct temperature and mixture of the wash-out solution.*
- *Minimum wash-out times.*
- *Sufficient drying time, in particular for halftone work.*
- *Uniform drying temperature.*

Insufficient polymerisation due to insufficient exposure times, an insufficient alcohol content of the wash-out solution, excessively high temperatures, or excessively long wash-out times will cause a stronger swelling of the relief. In this case, the plate will require a longer time to dry.

Measuring the Plate Thickness

The correct measurement of the plate thickness is subject to certain requirements, as the compressibility of the image elements may falsify the measuring results.

The following rules should be observed:

- *The measuring table should be sufficiently large, smooth, and even (ground stone or metal plate).*
- *The measuring table and the back side of the plate should be clean (remove any monomer residue left over from the wash-out process prior to measuring).*
- *Waves in the plate, i. e. if the plate does not lie completely flat on the measuring table, will cause measuring errors (if necessary, hold down the plate by means of vacuum).*
- *The measuring area of the plate must have a diameter of at least 10 mm. The same applies for the diameter of the measuring sensor.*
- *The contact pressure of the measuring sensor must not exceed 30 g/cm.*
- *Micrometer screws are not suitable for measuring flexo plates.*

Measuring the Plate Hardness

In flexo printing it is common practice to define the hardness of rubber-coated rollers or printing plates in Shore A values. According to the relevant DIN standard (DIN 53505), a minimum thickness of 6 mm of the material to be measured is required for such measurements. In the case of photopolymer plates, however, this requirement does not apply. There is a wide range of plate types available with a thickness below 6 mm.

During the processing procedure, the hardness of the Cyrel® plate is subject to considerable changes. However, the final value is obtained after post-treatment (finishing) and post-exposure are completed. The hardness can be measured using commercially available instruments, e. g. Zwick durometers. The measured values provide a realistic means of comparison with other plates of the same thickness.

2.6 STORAGE AND HANDLING OF CYREL® RAW PLATES

2.6.1 Storage

The guarantee period for Cyrel® raw material is 12 months. If stored and handled with proper care, however, the plates can be used for much longer periods of time without any deterioration in quality.

The boxes should remain unopened as long as possible and be stored in a flat position. Do not stack more than 10 packages of a particular size on top of each other! For larger storage quantities, racks containing several shelf levels are recommended. Do not store packages, even if still unopened, in direct sunlight or in the immediate vicinity of heaters/radiators, as heat causes premature ageing.

2.6.2 Handling and Storage

Opened boxes should not be stacked. Instead, they should be stored separately in a flat position. It is recommended to store plates in drawers, separated by foam interleaving. Please store plates in a cool and dry place (between 4 °C and max. 38 °C). Like graphic arts film, photopolymer plates must be conditioned to room temperature prior to processing. Opened boxes and unprocessed raw plates must be handled and stored under safelight conditions only.

Avoid white light and UV radiation, as exposure to daylight, fluorescent lamps, and light from normal filament lamps over longer periods of time can cause pre-polymerisation.

Windows and skylights should be screened off using DuPont UV Protection Film (article no. 6845049) or any other UV-light-proof material.

Amber, gold, or yellow fluorescent lamps are suitable for office and workplace lighting. The filter film mentioned above can also be used.

Never place heavy objects onto unpacked plates. When handling individual plates, in particular large sizes and narrow strips, they must be handled on one side only and transported in vertical position. Please do not stack plate fragments randomly; instead, plate fragments should be placed flatly side by side, separated by layers of smooth cardboard if possible.

Determining the Emulsion Side

2.6.3

To determine which side of the plate is the emulsion side, bend one plate corner upward. The side on which the film becomes detached is the emulsion side. The polyester backing will not detach itself by this procedure.

Do not remove the protective Mylar sheet until immediately prior to exposure, as the plates will age very quickly once the protective sheet has been removed.

Air bubbles trapped between the raw material and the protective sheet or partially detached protective sheets may affect the raw material. They can cause plate defects that will persist even after processing and affect the print result. Once the protective sheet is removed from the raw material, it cannot be brought back into perfect contact with the polymer layer. These plates should be processed immediately.

Cutting Cyrel® Raw Plates

2.6.4

A smooth, flat surface and sharp cutting tools are indispensable. Sufficiently durable paper shears have proven to be very suitable.



The shears should have little play. It is recommended to clean the cutting edge with a separating agent from time to time. Cutting tables with rotating, self-sharpening knives are available for cutting large-sized plates. We recommend the special Cyrel® Cutting Table.

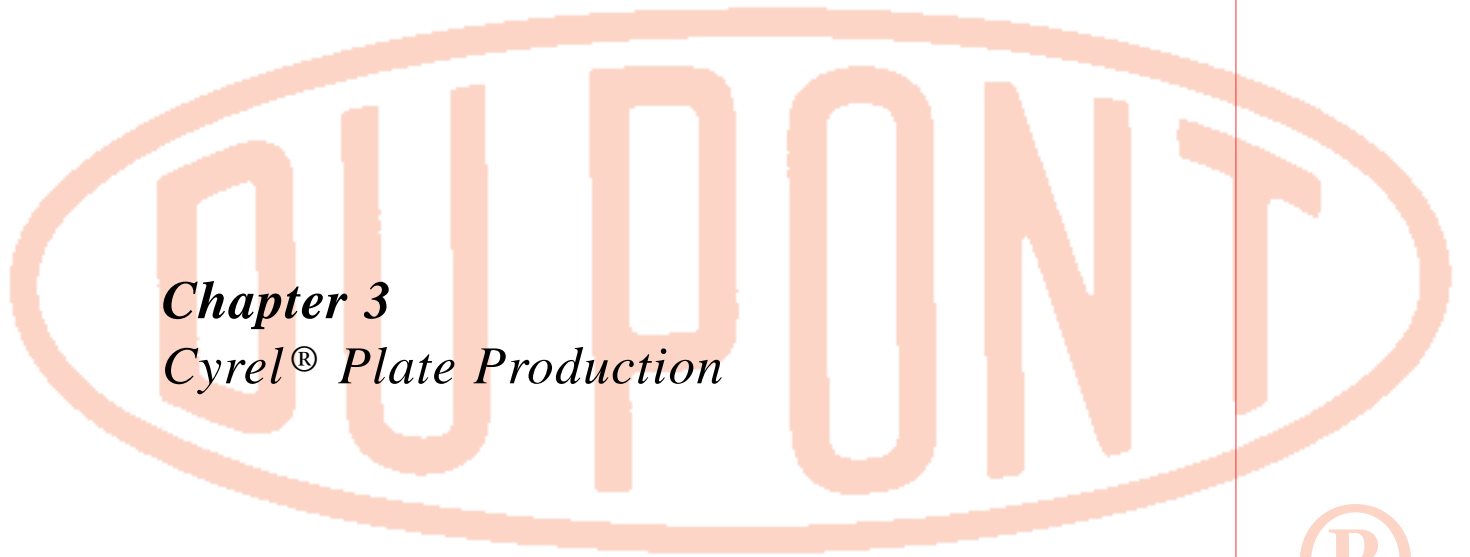
When using shears, the plates should be cut with the protective sheet facing upward. The cut should be performed quickly, applying a uniform pressure and pressing the knife against the cutting edge. A securing bar helps to hold the plate firmly in position.

So-called thermocutters should preferably not be used. If used, they should only be used under a vacuum device.

When cutting by hand, a stable guide (steel ruler) is required. The plate should be cut with the cover sheet against the cutting surface.

The plate cut should be calculated so that the plate is roughly 10 mm larger than the negative on each side. This will ensure optimum contact and a sufficient vacuum during the exposure process.





Chapter 3
Cyrel® Plate Production



CYREL® PLATE PRODUCTION

CHAPTER 3

The production of a Cyrel® relief plate involves six steps, four of which are carried out by way of an exposure process.

1. *Back exposure.*
2. *Main exposure (image exposure).*
3. *Wash-out.*
4. *Drying.*
5. *Post-treatment (finishing).*
6. *Post-exposure.*

3.1

JOB PREPARATION

- *Switch on the room ventilation and, if provided, the unit ventilation.*
- *Switch on the equipment and check whether the ventilator fans and heater/cooling device are operational.*
- *Check level of wash-out solution, check temperature of wash-out solution (target value between 15 and 25 °C for UniSol®/30 – 34 °C for OptiSol® and FlexoSol®.)*

Sort jobs according to plate thickness. When producing plates for very critical jobs, especially those involving multiple-ups mounted on one cylinder, carefully select the raw plates. Despite very strict manufacturing tolerances, a measurement of the overall thickness is recommended (measurement including protective sheet, sheet thickness = 0.005 inch or 0.0127 mm).

Inspect the negatives, with spotting out on the reverse side if necessary, cut

to size and compile to complete print formes for 1/1 or 1/2 plates requiring similar exposure conditions. The raw plates should be roughly 10 mm larger on each side than the negative forme. Perform test exposures to determine the required back and main exposure times for each plate.

EXPOSURE

3.2

Care – Cleanliness – Possible Faults

Thanks to the wide exposure latitude, the high sensitivity, and the excellent resolution of Cyrel®, even ultra-fine image details are reproduced faithfully on the plate.

On the other hand, these properties require the user to operate with utmost care and to ensure absolute cleanliness during plate production. Contaminations on the vacuum sheet, scratches or crimps in the negative, dust or lint in transparent areas of the film will be transferred to the plate and will subsequently be visible as printing errors.

The following notes will help you to ensure clean work and avoid the problems described above.

- *Keep negative preparation and exposure in separate rooms from other processing steps, and keep the working environment free of dust. Clean the floors daily.*
- *Clean both sides of the vacuum sheet as regularly as possible with a film cleaning agent, replace by a new sheet if necessary.*
- *Keep the exposure unit clean. Dust will collect very quickly on the cover of the exposure unit and on the surface of the exposure lamps, and will then*

fall onto the vacuum sheet. Also, the dust filters of the cooling fans and the vacuum channels will clog up from time to time and therefore require regular cleaning. Replace the dust filter of the vacuum pump as necessary.

- *Try to keep the exposure unit closed as much as possible. Open the cover only for the purpose of inserting and removing plates.*
- *Lightly clean the negatives and the plate surface (protective sheet) prior to exposure with an antistatic cloth or a soft brush. Do not wipe too vigorously, as the plate will otherwise become electrostatically charged and will attract dust. It is recommended to perform this cleaning operation not on the exposure unit, but on a separate table. The use of antistatic guns, which operate with ionised compressed air, may also be useful.*
- *Leave the protective sheet on the plate as long as possible.*
- *If the film needs to be smoothed out during the vacuum process, it is recommended to use a piece of cardboard or an antistatic cloth. Be careful, however, if your hands are soiled, for example with masking fluid. It will be transferred to the vacuum film and may cause exposure problems.*

3.3

BACK EXPOSURE

Back exposure is the first step in printing plate production. This is the uniform exposure of the plate through the backing (reverse side) without a vacuum and without a negative.

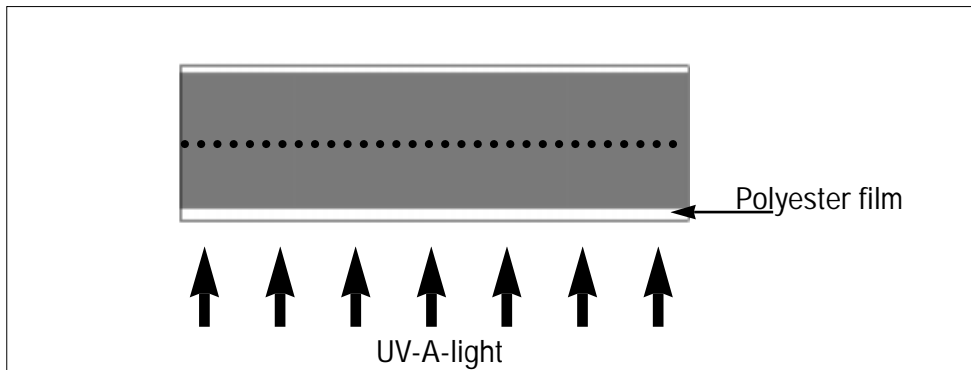


Fig. 4: Back Exposure

The plate, cut to film size, is placed on the exposure unit with the backing facing the lamps, and exposed without a vacuum and without a negative for the calculated period of time (1002 exposure unit).

When working with a 2001 or 3002 exposure unit, back exposure is effected from the bottom through the glass plate. It is therefore prepared together with the main exposure.

Purpose of the back exposure process:

- *To reduce, by way of photosensitisation (enhancing of sensitivity), the subsequent image exposure, especially for isolated and fine image elements.*
- *To ensure a stable side wall structure and to increase the plate run length by creating a durable bond between the image elements and the relief base.*
- *To ensure bonding between the polyester backing and the polymer layer.*

- *To build up the relief base by controlled pre-polymerisation in the immediate vicinity of the polyester backing, at the same time ensuring a clean surface.*
- *To limit the absorption of solvents and the possible wash-out depth during the wash-out procedure.*

Back exposure is an important part of plate production. It must always be performed, and the exposure time must be calculated by a corresponding test.

i *(The calculation of back exposure time is described in Chapter 4.1)*

3.3.1 Effects of Back Exposure

The sensitisation process begins immediately when the back exposure process starts. During this process, any oxygen that entered the layer during storage of the raw plates is used up, initially without a relief base being built up.

The creation of the relief base is not performed until the oxygen has been bonded by polymerisation of the monomers. As back exposure progresses, the relief base becomes stronger while the possible relief depth is reduced. The back exposure time should be calculated to ensure that the desired relief base – i. e. the difference between the desired relief depth and the overall thickness – is fully polymerised.

3.3.2 Correct Back Exposure

Correct back exposure has a positive influence on the reverses and the negative image elements. It limits the possible wash-out depth. Even in the event

that wash-out times are longer than required, the relief will not become any deeper.

Insufficient Back Exposure

3.3.3

If back exposure times are too short, a layer that is only partially hardened will be left between the polymerised relief base and the image relief. During the wash-out process, this can lead to faulty results, notching, or erosion of fine image elements.

On the surface of the relief base, a non-polymerised, unhardened layer remains. This layer is not washed off. After drying, the base of the plate displays a greasy lustre and monomer "shadows" surrounding individual image elements.

The wash-out solution, containing accumulated monomers from the relief base, is relatively viscous and can therefore not be completely washed off. It runs back onto the image surface, creating deposits which subsequently lead to printing problems. The dried monomer residues must therefore be removed in the initial stage of the drying process.

Insufficient photosensitisation requires an extension of the main exposure time.

The durability and run length of the plates is limited.

Excessive Back Exposure

3.3.4

The relief base built up is too high, the desired relief depth is not achieved. The reverses are adversely affected or may even be filled in by the exposure process.

3.3.5

Selecting the Relief Depth

The relief depth can be set to suit the different areas of application, with back exposure and wash-out times adjusted accordingly.

For standard printing conditions, a relief of 1 mm is recommended.

i

(Please also refer to Chapter 2.4 Plate Thickness and Relief Depths.)

3.4

MAIN EXPOSURE (IMAGE EXPOSURE)

Main exposure is the second processing step in the production of photopolymer printing plates and should be performed immediately following back exposure.

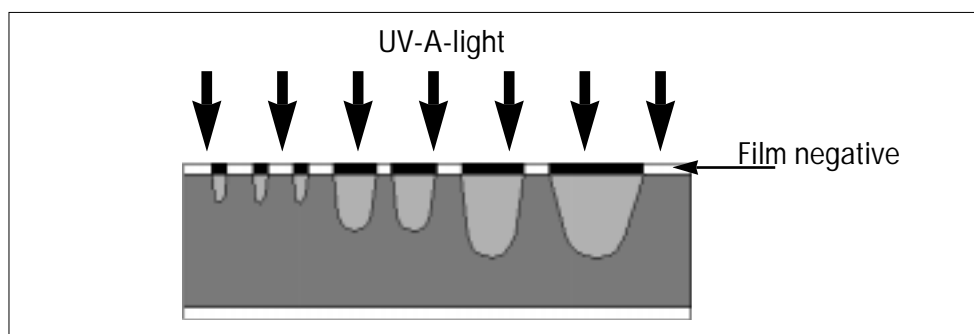


Fig. 5: Main exposure

3.4.1

Main Exposure

Turn the plate over (in 1002 exposure unit only), lift off the protective sheet in one corner of the plate and remove it from the plate in a single smooth

movement. If necessary, remove dust or lint with the aid of an antistatic cloth or an antistatic gun.

Place the negative on the plate with the emulsion (matte) side facing the plate. Then mask the negative and the plate edges with masking foil.

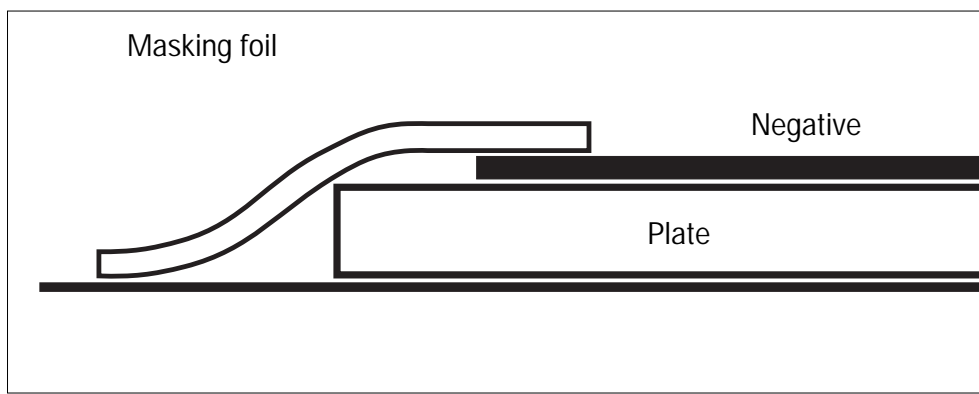


Fig. 6: Masking the plate edges with masking foil

The masking foil must be matte on both sides or have embossed air channels. If necessary, the foil strips should be extended up to the air channel of the exposure unit. Switch on the vacuum and move the vacuum sheet across the plate and the film, taking care not to displace the negative and the vacuum strips. Use an antistatic cloth to remove any contaminations between film and vacuum sheet or between film and plate.

Then brush out the air from the centre of the plate towards the edges and smooth out the sheet with the palm of your hand, an antistatic cloth, or a strip of cardboard. Air bubbles trapped between the film and the plate will cause exposure problems (side lighting). To avoid light scatter in exposure units equipped with a glass plate (2001/3002), cover the free areas surrounding the Cyrel® plate with light-proof material.

It is important to create a connection from the plate to the vacuum channels with the masking foil. Sufficient time is needed to extract the air. Brush out the air from the centre of the plate toward the edges. Make sure that the vacuum sheet is completely flattened out. If brushing over the sheet still causes creases, the vacuum is not sufficient.

3.4.1.1 Selecting the Exposure Times

The exposure time depends on plate type, image, negative specifications, exposure unit, etc.

The required exposure time is calculated in prior exposure tests.

3.4.1.2 Exposing Deep Relief Plates (Plate Thickness of 4 mm and More)

Due to the greater relief depth, the exposure times for these plates are generally longer than for standard plates.

To determine the main exposure time, a special test negative has been developed (see Chapter 4.2.2) which contains the relevant image details for this area of application.

3.4.2 Purpose of Main Exposure

- *To generate the relief image required for the printing process and to ensure that the image elements are firmly anchored to the relief base built up during back exposure.*

Effects of Main Exposure

3.4.3

During main exposure, the actual relief is created by polymerisation of the monomers. The image is created at the plate surface and extends conically downward into the emulsion layer. Initially, however, it is still surrounded by unpolymerised monomers and fillers.

Unlike back exposure, main exposure is performed from the emulsion side, through the negative. During the process, the negative is held to the plate surface by means of a vacuum after the protective sheet has been removed.

The exposure time is sufficient if all image elements are firmly anchored to the relief base built up during pre-exposure. There should be no unpolymerised material left between the image relief and the relief base.

Parameters Influencing Main Exposure

3.4.4

The main exposure time depends on a variety of factors:

- *Intensity of UV radiation.*
- *Sensitivity of the raw material.*
- *Required relief depth.*
- *Nature of the image elements of the negative.*

On commissioning of the unit and when using new raw materials, the correct exposure times must first be established by means of tests.

(Please also refer to Chapter 4)

i

As the UV output of the lamps decreases with the number of operating hours, it is recommended to check the light intensity at regular intervals.

3.4.5 Influence of Main Exposure Time on Image Build-Up

The main exposure time should be as long as necessary and as short as possible. The correct exposure time depends on the nature of the image details to be transferred from the negative to the printing plate.



The following minimum values should be observed:

- *Isolated lines: 0.17 mm.*
- *Isolated dots: 0.25 mm.*
- *Type size: 4 points*
- *Highlight screen dot: 2% at 60 L/cm.*



(For details on how to calculate the main exposure time, please refer to Chapter 4.1.4)

3.4.6 Insufficient Main Exposure

- *Polymerisation does not extend down to the relief base, the side walls of the image elements remain too steep; the cone produced is insufficient.*
- *During the wash-out process, the dot side walls are eroded, fine lines become wavy and fail to stretch out again.*
- *Isolated dots or halftone areas made up of sharp dots (highlights) fall over or are washed away, image detail is lost.*
- *The image surface tends to display a "crescents" effect, the service life of the finished plate is shorter.*

Excessive Main Exposure

3.4.7

The main exposure time is sufficient if all image elements of the negative are firmly anchored to the plate. A longer exposure time will adversely affect the negative image details.

- *Reverses are shallower or filled in, negative image detail is lost.*
- *Overexposed plates have unsharp contours and display a tendency to fill in during printing.*
- *When printing halftones, image dot gain is increased and shadow detail is reduced.*

Exposure Latitude – Transfer Accuracy of Image Data from Film to Plate

3.4.8

An essential feature of Cyrel® printing plates is the correct tonal transfer of the film image data to the raw plate. The two-dimensional film image is converted to a three-dimensional relief. The line width or the dot or cell diameter accurately reflect that of the film. As exposure progresses, the depth of the cells or the spaces between the individual image elements become shallower. This applies in particular to negative image elements, e. g. typefaces in solid areas or shadow dots in halftone areas with an area coverage of 70% or more.

The decisive factor for assessing the exposure latitude is first of all the minimum exposure time necessary to firmly anchor the image elements on the relief base and build up a side wall. To achieve this, diffused light is required; a point light source is not suitable.

The exposure latitude can be regarded as sufficient if the main exposure is sufficient to ensure the minimum values specified above (0.17 mm wide positive line, 2% at 48 L/cm), while at the same time the depth of a 0.8 mm wide negative line exceeds $100\text{ }\mu\text{m} = 0.1\text{ mm}$. For standard plate thicknesses up to 3 mm, these values are achieved in a single exposure.

3.5

WASH-OUT PROCESS

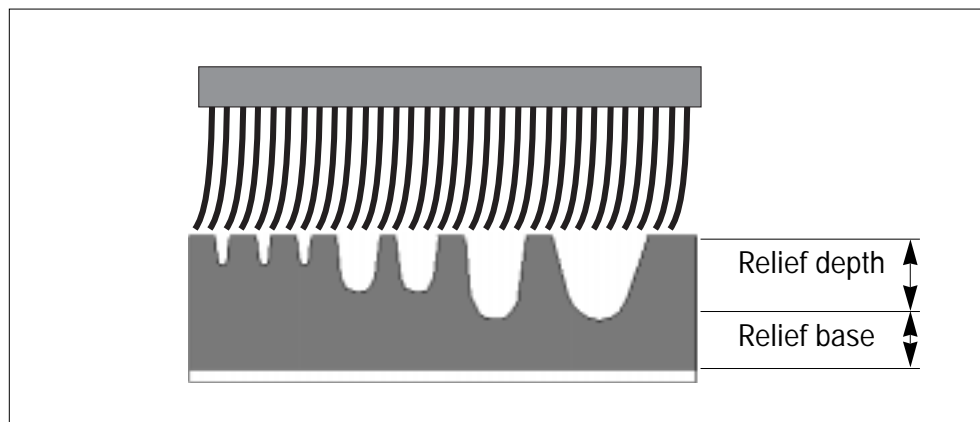


Fig. 7: Wash-out process

During the wash-out process, the unexposed, non-polymerised photopolymer is dissolved and removed from the plate, leaving the polymerised relief image on the plate.

Wash-Out Procedure

3.5.1

- *It is recommended (though not crucial) to wash out the plate immediately after main exposure has been completed. The period between exposure and wash-out may be several hours, provided protection against inadvertent external exposure is ensured during this time.*
- *The exposed plate is mounted emulsion side up onto the drum of the processor or inserted in the in-line processor.*
- *Wash-out time and contact pressure depend on the required relief depth. They are calculated in prior tests and are pre-set accordingly before starting the wash-out procedure. In modern processors, these settings are programme-controlled.*

Parameters Influencing the Wash-Out Procedure

3.5.2

The wash-out time depends on:

- *The composition of the wash-out solution.*
- *The temperature of the wash-out solution.*
- *The processor design.*
- *The brush contact pressure.*
- *The plate type.*



3.5.3 The Effects of Various Wash-Out Conditions

3.5.3.1 Relief is too Shallow

- *Wash-out time too short, temperature too low, brush pressure incorrectly set.
(Brush pressure too low: Brushes fail to touch the plate surface. Brush pressure too high: Bristles are bent, wash-out performance deteriorates.)*
- *Insufficient wash-out recirculation due to clogged filters.*
- *Solution excessively saturated.
(Regeneration incorrectly set, alcohol content too high.)
Insufficient regeneration due to clogged filter.*

3.5.3.2 Relief is too Deep

- *An excessively deep relief is only produced in connection with insufficient back exposure times.*
- *Wash-out time too long, temperature too high, alcohol content too low.*
- *On initial commissioning of the unit and when using a new plate type for the first time, the correct wash-out time needs to be established by means of a test.*

Regeneration of the Wash-Out Solution

During the wash-out procedure, the wash-out solution absorbs the dissolved monomer. With progressing saturation, the wash-out capacity diminishes. The solvent must therefore be regenerated by adding fresh wash-out solution.

- *The regeneration of the wash-out solution depends on the plate size and the relief depth. The calculation is based on approx. 10–15 litres of wash-out solution per square metre of washed plate surface and mm of relief. The regeneration is calculated to ensure that the used wash-out solution contains roughly 4–6% dissolved monomer.*
- *Depending on the unit type, the regeneration is adjusted either manually or automatically. It can generally be controlled with the aid of a flow metre.*
- *When processing deep relief plates, the regenerated quantity needs to be increased in comparison to standard plates in accordance with the relief depth.*
- *Excessive regeneration has no adverse effects, though it may reduce economy. Insufficient regeneration decreases the quality, and the wash-out procedure is slowed down. Polymer residue is left on the surface. The plates display a tendency to develop "orange peel" effects and drying spots.*
- *If the back exposure time was too short for the desired wash-out depth, the brushes may cause grooving (brush marks) which can only be made to disappear by extending the wash-out time. If the wash-out time is not adjusted, non-dissolved polymer residue will be left on the polymerised relief base. It will be absorbed by the wash-out solution during the subsequent wash-out procedure and is the reason for drying spots on the finished plate.*

3.6

DRYING OF WASHED-OUT CYREL® RELIEF PLATES

After completion of the wash-out procedure, the swollen relief plates are returned to their original thickness by means of hot air in a drier.

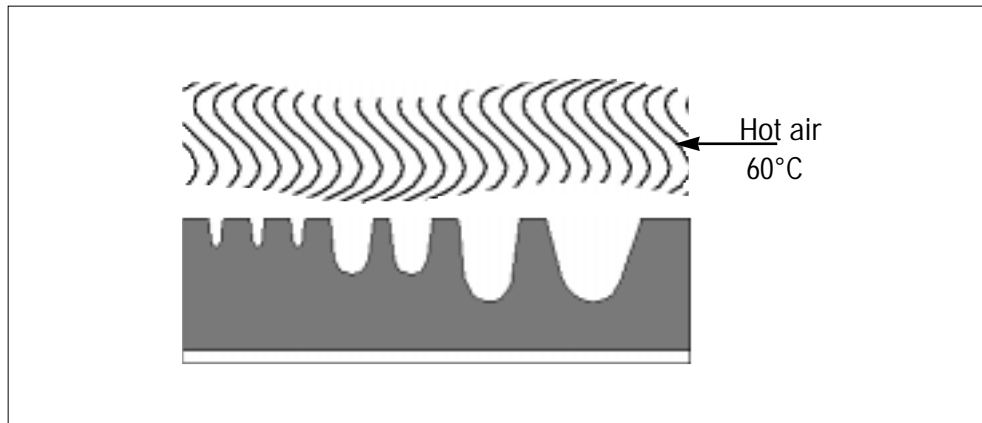


Fig. 8: Drying

3.6.1

Drying Procedure

Drying is crucial to the plate quality. It is especially significant with a view to the plate's ability to resume its normal thickness.

Therefore, the following should be observed:

- *Make sure the correct drying temperature is maintained. Temperatures exceeding 65 °C may adversely affect dimensional stability, because the polyester film, which maintains its dimensional stability under normal conditions, will shrink. Temperatures below 60 °C will result in longer drying times.*
- *Check the plate surface after washing and – if necessary – clean it with wash-out solution.*

Recommended drying times:

- *OptiSol® 737: 2 hours.*
- *FlexoSol® and UniSol®: 3 hours.*
(Avoid longer or shorter drying times.)
- *The dryer compartments should not be filled right up to the front edge.*
- *Allow the plates to cool prior to finishing.*

Even correctly processed photopolymer plates may lose 1 – 2% of their overall thickness during storage, even after finishing. If individual plates from a previously prepared set need to be reproduced, they are generally thicker after standard processing.

Effects of the Drying Procedure

3.6.2

During the wash-out procedure, the plate absorbs wash-out solution, and the polymerised relief image is soft and swollen.

Absorption of wash-out solution depends on the polymerisation of the relief image and on the wash-out time and the type and temperature of the wash-out solution. The average time in the drier depends on the extent of plate swell and on the wash-out solution used, and is normally between 2 and 3 hours. The temperature must not exceed 65 °C.

If the plates are subjected to finishing prior to resuming their normal thickness, diffusion of any amounts of wash-out solution still present in the plate will be difficult and irregular. The finished plates will display considerable variations in thickness. Therefore it is imperative to ensure a correct drying procedure.

After drying, the plate surface will still be slightly tacky. Therefore, the plates should not be stacked or brought into contact with other objects. At this time, the plates are especially susceptible to contamination, daylight, and exposure to ozone. The tackiness will not disappear until after finishing.

3.7

FINISHING OF CYREL® PRINTING PLATES

After completion of the drying procedure, the plate is subjected to a finishing procedure.

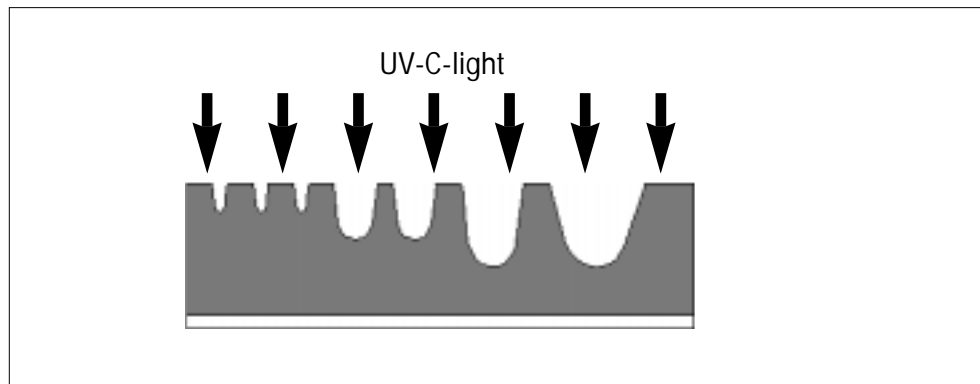


Fig. 9: Finishing

3.7.1

Finishing Procedure

- *The finishing time depends on the amount of solvent residue still present in the material after drying.*
- *The drying or resting time may therefore influence the result. We recommend to perform the finishing procedure immediately after the correct drying procedure.*

- *The reaction of the different monomers to UV-C radiation varies. The required time must therefore be established beforehand by way of tests.*
- *Finishing may be interrupted for the purpose of inspection and subsequently resumed.*
- *Plates dried over very long periods of time may cause problems (if not finished immediately after drying). On no account must the plate be wiped with fresh wash-out solution prior to finishing.*
- *The permissible tolerance is limited by a temperature rise during the finishing procedure. To avoid overheating of the unit at high room temperatures, it is recommended to perform the finishing and final exposure procedures separately one after the other.*
- *If the finishing time is too long, cracks may appear in the plate surface.*

Effects of Finishing

3.7.2

The dried Cyrel® plate normally has a glossy and slightly tacky surface. For this reason, it is susceptible to contamination and changes due to exposure to pressure and air. Its final surface qualities, precisely tuned to the printing process, are achieved by finishing.

The plate's final surface properties are achieved by exposure to short-wave UVC light, which preserves the glossy surface.

3.7.3

Important Safety Notes

The UVC radiation required for finishing is hazardous to the human skin and in particular to the eyes.

Even brief exposure may cause skin burns (similar to sunburn) and damage to the conjunctiva and retina.

During finishing, the unit must therefore be kept closed. Never look into the exposure unit with your eyes unprotected (use UVC protective goggles).

3.8

POST-EXPOSURE (FINAL EXPOSURE)

This final step in the production of Cyrel® plates is performed either together with or after completion of the finishing procedure.

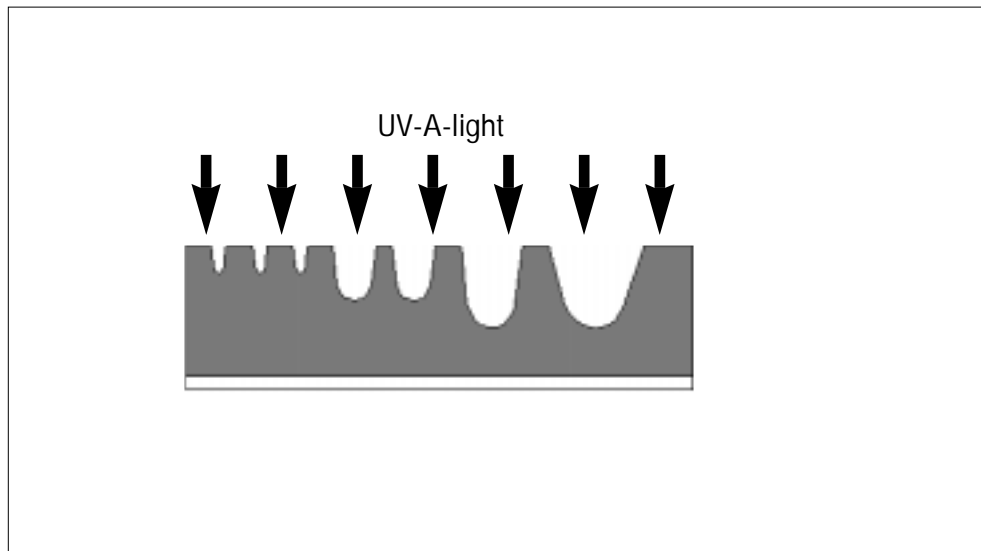


Fig. 10: Post-exposure

Post-Exposure

3.8.1

To ensure that all monomers contained in the relief are polymerised during processing, the plate is subjected to a post-exposure procedure. This procedure uses the same type of UV light (UV-A) used for back and main exposure. It gives the plate its final hardness and durability.

Purpose of Post-Exposure

3.8.2

Post-exposure is necessary to ensure that all unexposed polymers in the plate are polymerised and cross-linked. Unless cross-linking of all monomers is complete, a sufficient service life of the printing plate is not guaranteed. If the post-exposure time is too short, fine details may be lost in the course of the printing process. As a result, in particular in halftone plates, highlight dots may break out or fail to print accurately.

Effects of Post-Exposure

3.8.3

- *Post-exposure increases the plate's resistance to ink solvents and washing solutions and gives the plate its final hardness.*
- *The effectiveness of the post-exposure procedure depends on the UV output of the exposure lamps. It is effected in normal exposure units from the front side, without a negative and without a vacuum.*
- *Post-exposure time is 10 minutes depending on the unit type. In units with older lamps, an extra five minutes should be added to this exposure time.*

- *Post-exposure can be effected together with finishing. At high room temperatures (>28 °C), finishing should be performed prior to post-exposure.*

3.9

CUTTING THE FINISHED RELIEF PLATE

To ensure optimum adhesion of the plate on the printing cylinder and to prevent the plate edges from lifting off during the print run, the plates should be cut 5 – 8 mm larger than the image area on each side. It is recommended to cut the plate edges at a bevel.

3.10

QUALITY CONTROL

Cyrel® printing plates are manufactured with greatest possible care to meet the most demanding quality requirements. However, the plates are subject to a variety of influences during processing which may result in problems. Therefore, the plates should be checked prior to delivery to the customer. Potential sources of problems are frequently already present in the original negative. Print quality is influenced to a great extent by the uniformity of the plate thickness, which depends largely on the processing conditions. Regular checks will ensure that defective plates are not delivered to customers.



Chapter 4
Basic Tests



BASIC TESTS

CHAPTER 4

4.1

BASIC TESTS FOR ESTABLISHING THE PROCESSING PARAMETERS FOR CORRECT PLATE PRODUCTION

Four processing parameters are crucial for the production of a Cyrel® relief plate. They differ for each plate type and need to be established by performing the relevant tests.

- *Back exposure time.*
- *Main exposure time.*
- *Wash-out time.*
- *Finishing time.*

The wash-out time generally remains constant over a longer period of time and requires checking or recalculation only under certain conditions:

- *On production start of a new unit.*
- *After resetting the brushes.*
- *When using a new plate type.*
- *When using a new wash-out solution.*
- *When the relief depth changes.*

Back and main exposure times, however, need to be redefined for each new plate emulsion (batch). Although these values depend primarily on the sensitivity of the raw material, these tests also take into consideration the aging process of the lamps (change of UV output). It is quite normal for exposure times to differ for different exposure units.

Back Exposure Test

General Notes:

- *The test conditions should reflect as closely as possible the subsequent production conditions. For this reason, the lamps should be switched on at least 5 minutes before performing the test.*
- *Since raw materials featuring the same manufacturing numbers have the same sensitivity, the test generally needs to be performed only for plates from a new batch.*
- *Please note that the UV output of new lamps decreases over the first few operating hours. „Burning in“ will take this fact into consideration.*

Performing the Test

On the reverse side of a strip of raw material approx. 20 x 50 cm in size, mark with a ball-point pen 6 sections roughly 8 cm wide and one strip across the top.

The plate is placed on the exposure unit with its protective sheet still intact and its reverse side facing the back exposure lamps. It is then exposed step by step without a vacuum.

In the 2001 and 3002 exposure units, the plate must be covered with light-proof material. Otherwise, light reflections will cause additional exposure from the emulsion side, in which case the plate can no longer be washed out.

- *For thin plates up to Type 67 (1.70 mm),
steps of approx. 2, 4, 6, 8, 10, 12 seconds are used,*
- *for plates up to Type 185 (4.7 mm),
steps of approx. 20, 40, 60, 80, 100, 120 seconds are used,*
- *for thick plates from Type 197 (5.00 mm),
steps of approx. 120, 150, 180, 210, 240, 270 seconds are used.*

The length of the intervals depends on the intensity of the UV output.

Be sure to expose absolute times (e. g. 30 s, and not 10 + 10 + 10s), otherwise the exposure error due to the start-up phase of the tube lamps will be too great.

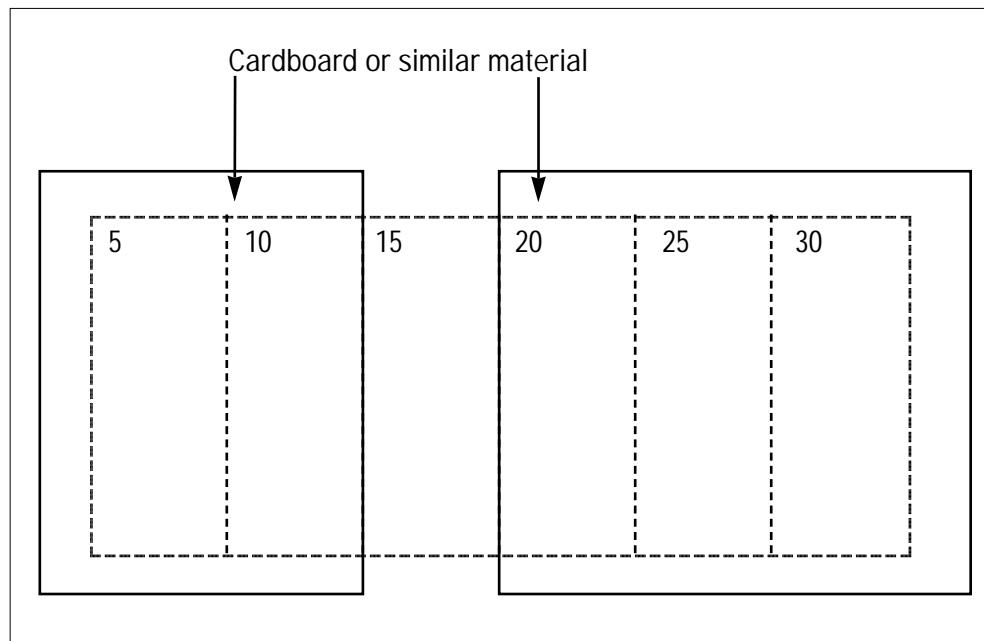


Fig. 11: Exposure of the individual sections

After completing the exposure series, the protective sheet is removed and the surface covered in such a way that only the marked strip across the top (approx. 5 cm) remains uncovered. This strip is then exposed from the emulsion side for a period of 4 – 8 minutes depending on the plate thickness. The test strip is subsequently washed out until the section with the shortest exposure time is clean and free of smears.

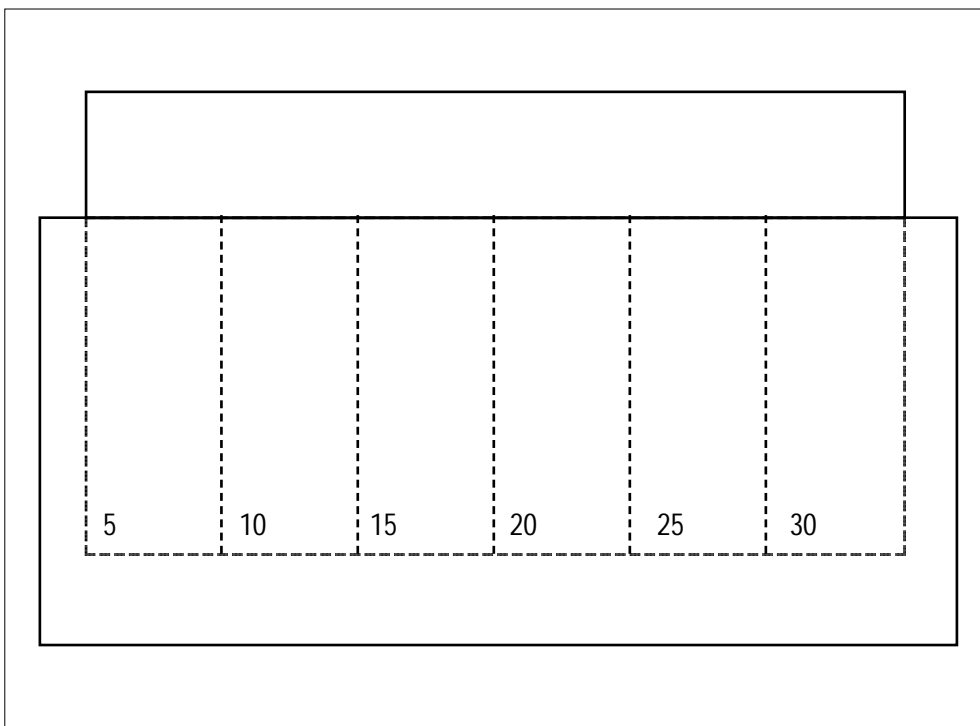


Fig. 12: Exposure of the reference area

Establishing the Back Exposure Time

4.1.1.1

The washed-out test strip is dried for 30 minutes and then left to cool down to room temperature. The result is a plate with a stepped gradation. The individual sections are measured with a thickness gauge.

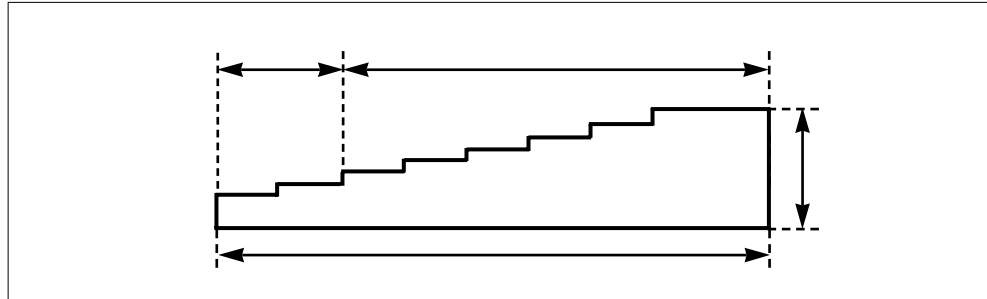


Fig. 13: Washed-out test strip

The difference between the measured values and the thickness of the reference area establishes the relief depth for each back exposure. By entering the measured values in a graph in relation to the back exposure times applied, the back exposure time for any required relief depth can be established.

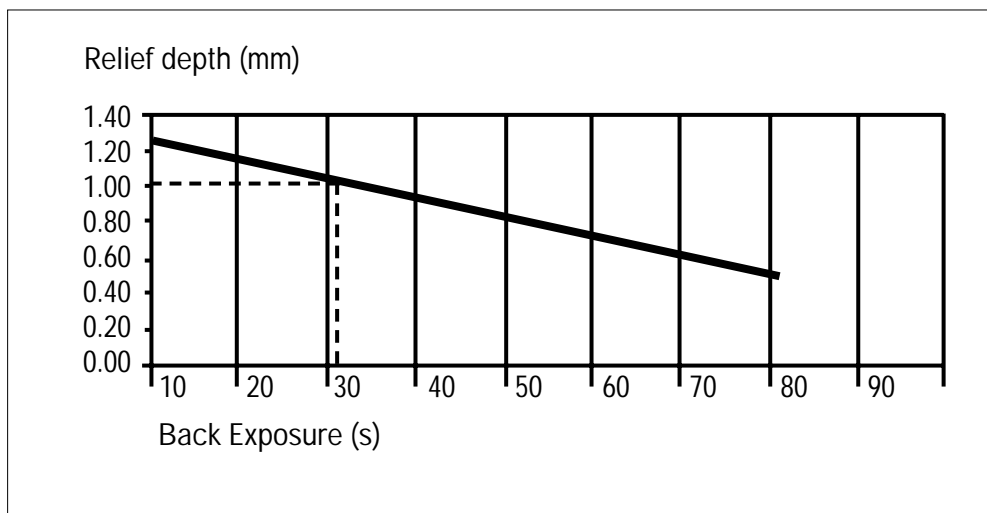


Fig. 14: Relief depth in relation to exposure time

Wash-Out Test

4.1.2

The purpose of the wash-out test is to establish the wash-out time required to obtain a certain relief depth.

The procedure is based on the assumption that a certain brush pressure is set for the different plate thicknesses which remains constant, that the temperature of the solvent remains constant throughout the tests and processing, and that the solubility of the wash-out solution is maintained by regeneration.

The wash-out test is always performed with back exposure. Therefore, the back exposure test must be performed before the wash-out test.

Performing the Wash-Out Test:

Four correctly exposed plates (with back exposure and main exposure) are washed out in the processor for different lengths of time. The size of the test plates is identical to the width of the processor used, with a minimum length of 25 cm.

The following times may be used as a reference:

- *Plates with a relief depth of approx. 1 mm: 4, 6, 8, 10 minutes.*
- *Plates with a relief depth of approx. 3 mm: 8, 10, 12, 16 minutes.*

The plate is sufficiently washed out if the relief base is smooth and no longer displays a greasy lustre, and if no monomer "shadows" are visible around the relief.



If the processor is filled with fresh wash-out solution, please bear in mind that this will wash out far more quickly than wash-out solution already containing accumulated monomers.

The wash-out time thus calculated applies to the used unit and the prevailing conditions (temperature, solvent, etc.). It should be established once for all potential plate types.

In automatic continuous processors offering comprehensive programming options, the corresponding values are programmed during installation.

4.1.3 Quick Tests for Wash-Out and Back Exposure Times

If practical experience has shown a certain range for wash-out time and back exposure time, an abbreviated test may be used.

4.1.3.1 Establishing Wash-Out Time

Two test plates whose width is identical to that of the entry width of the processor and whose length is 25 cm are exposed from the back, and with an image from the front. They are then washed at constant brush pressure (standard setting for the material used) for a period 2 minutes shorter and for a period 2 minutes longer than the normal wash-out time.

The samples are then dried for 30 minutes.

i *(The evaluation is performed as described in 4.1.2 "Wash-Out Test".)*

Establishing Back Exposure Time

A Cyrel® test strip (approx. 20 x 15 cm) with protective sheet is exposed from the back using two different exposure times, with one being shorter than the expected correct back exposure time and the other longer. For example, if the correct back exposure time is expected to be 40 seconds, the plate samples are exposed for 30 and 50 seconds.

The sample is then reversed, the protective sheet removed, and two thirds of the plate covered with light-proof material. It is then subjected to a main exposure of 4 – 8 minutes depending on the plate thickness.

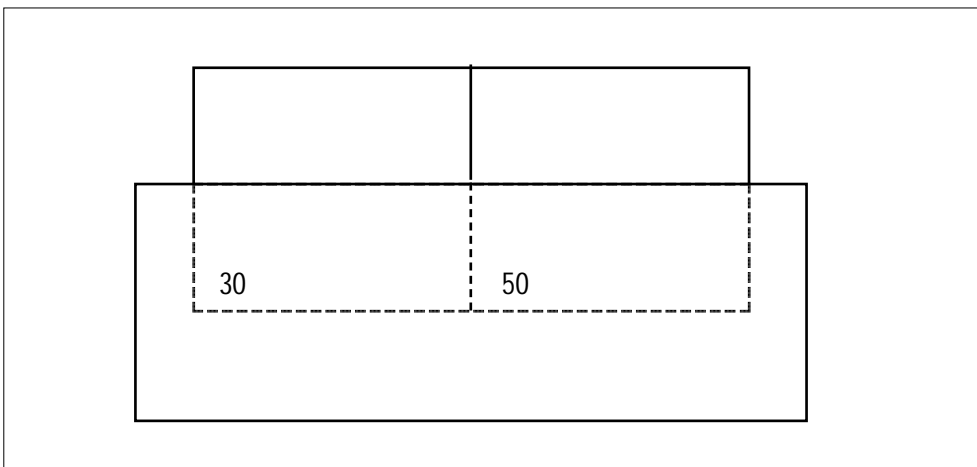


Fig. 15: Quick test for establishing back exposure time

The subsequent wash-out procedure must be long enough to ensure that even in the case of short back exposure, all unpolymerised material is washed out.

After the plates have dried for 30 minutes and cooled down to room temperature, the relief base and the corresponding relief depth are measured. The established values are entered in a form in relation to the corresponding pre-

exposure times and connected by a line, allowing the back exposure times required for any relief depth to be established at a glance.

This abbreviated test produces sufficiently accurate results as long as the selected times are within the range of the correct values. In borderline areas, however, there may be variations.

4.1.4

Main Exposure Test

The tests described above make it possible to accurately establish back exposure and wash-out times. These times remain largely constant, at least for the emulsion used.

In main exposure, the parameters plate sensitivity and UV output are as crucial as the properties of the film originals. They determine the amount of light (energy) that reaches the plate and causes polymerisation.

Polymerisation begins at the plate surface and extends downward as exposure progresses. In this context, it is important to ensure that after completion of the exposure the individual image elements are firmly anchored to the relief base. There must be no area of unpolymerised material left between the relief and the base built up during back exposure.

A negative with small image windows (fine linework, halftones) allows only small amounts of light to penetrate; therefore, the exposure time must be longer.

Special main exposure negatives are available from DuPont on request. This can be used to establish the required main exposure time by means of step exposure.

i

(For a detailed description of the test negatives, see Chapter 4.2)

Main Exposure Text

4.1.4.1

1. *Subject a Cyrel® plate to back exposure in accordance with the test.*
2. *Remove the Mylar protective sheet and position the test negative on the plate. Remove any contaminations (dust, lint, etc.), especially from the transparent film areas.*
3. *Cover the plate edges with masking foil. Make sure a perfect vacuum is achieved to ensure that the negative has optimum contact with the plate surface. Remove any air bubbles and creases to prevent exposure errors (side lighting).*
4. *The individual steps of the test negative are subjected to different exposure times.*

The following exposure times can be used as reference values:

- *Cyrel® HCS and Cyrel® HOF: 3, 4, 5, 6, 7, 8, 9, 10 minutes.*
 - *All other types with thicknesses from 30 to 125: 4, 6, 8, 10, 12, 14, 16, 18 minutes.*
 - *TDR 155 – 250: 8, 12, 16, 20, 24, 28 minutes.*
5. *After main exposure, the plate is washed out in the time previously established and subsequently dried.*

4.1.4.2

Establishing the Main Exposure Time

The correct exposure time is the time that is necessary to achieve an accurate reproduction of isolated dots with a diameter of 0.25 mm, isolated lines of 0.17 mm width (0.25 mm from type 155 up), and fine highlights. When evaluating the halftone areas, the screen ruling corresponding to the current jobs should be evaluated.

If dots are washed away and/or the lines are still wavy, the exposure time is too short.

Please bear in mind that slight waviness will straighten out during the drying process. A final evaluation is therefore not possible until the drying process is completed.

The main exposure time increases with the age of the tube lamps. An operating hour counter is helpful to ascertain the age of the lamps.

Negative type or linework require shorter main exposure times than the positive image elements. Longer exposure times can then result in shallower reverses. In practical work, of course, sufficient depth of the reverses is required. Print tests have shown that to achieve excellent print results it is sufficient if a 0.8 mm wide line within a solid area has a depth of 100 µm (0.1 mm).

Optimum results with halftone formes are achieved if the following basic rules are observed:

- *Select the screen ruling to match the printing substrate.
Coarse screens may be better than fine screens.*
- *Select a wash-out depth that is no deeper than absolutely necessary.*
- *Select a main exposure time that is just long enough to ensure that the highlights are maintained.*

Combining Halftone and Linework

4.1.4.3

Normally, when using Cyrel® flexo printing plates, halftone and linework can be exposed onto a plate and printed together on one cylinder. In the case of especially critical work, in particular when running printing cylinders with a small diameter, halftone areas may print out higher than linework or solid elements, and a greater contact pressure may be required. If this leads to problems, e. g. dot squeeze, it may be helpful to print line and halftone work on separate cylinders.

Finishing Test

4.1.5

The required time is easy to establish. A fully dried plate is exposed for 4 minutes and subsequently checked for tackiness. This procedure is repeated in two-minute steps (one-minute steps for Cyrel® TDR, HOF, POF) until the tackiness has been eliminated.

This test is performed for up to 10 minutes with the UV-A tube lamps. It is then continued only with UV-C light.

The time required depends on:

- *Type of material.*
- *Type of wash-out solution.*
- *Drying time.*

Cyrel® TDR, HOF, POF, CL respond very quickly, i. e. < 10 minutes,
Cyrel® HOS and UVP have a medium response time of around 10 minutes,
Cyrel® HCS, PLB and PLS respond slowly, i. e. > 10 minutes.

Please ascertain that the plates do not display cracks or a matte structure when strongly bent, paying especial attention to the side walls!

4.2 TEST NEGATIVES FOR ESTABLISHING MAIN EXPOSURE TIMES

Two different versions are available:

Standard test negatives: For plates up to an overall thickness of 3.18 mm.

Deep-relief test negatives: For plates with an overall thickness of 3.94 – 6.50 mm.

The negatives consist of a combination of equal sections with different positive and negative image elements.

4.2.1 Standard Test Negative for Plates with an Overall Thickness up to 3.18 mm (125 mil)

It features:

- *Positive and negative lines with widths of 0.17, 0.25, and 0.8 mm.*
- *Positive and negative isolated dots with a diameter of 0.25, 0.50, 0.75 and 1 mm.*
- *Halftone areas with a screen ruling of 42, 48, and 54 lines per centimetre and an area coverage of 2, 3, and 95%, as well as a vigneted halftone wedge with a screen ruling of 48 L/cm (up to 0.5% area coverage).*

A scale is positioned next to the vignettted halftone wedge to indicate at which point (after a certain exposure time) the vignette is interrupted.

Main Exposure Test Negative for Deep-Relief Plates (3.94 – 6.5 mm)

4.2.2

This features image elements specifically designed to comply with the requirements of printing on corrugated board or similar substrates with a coarse surface structure.

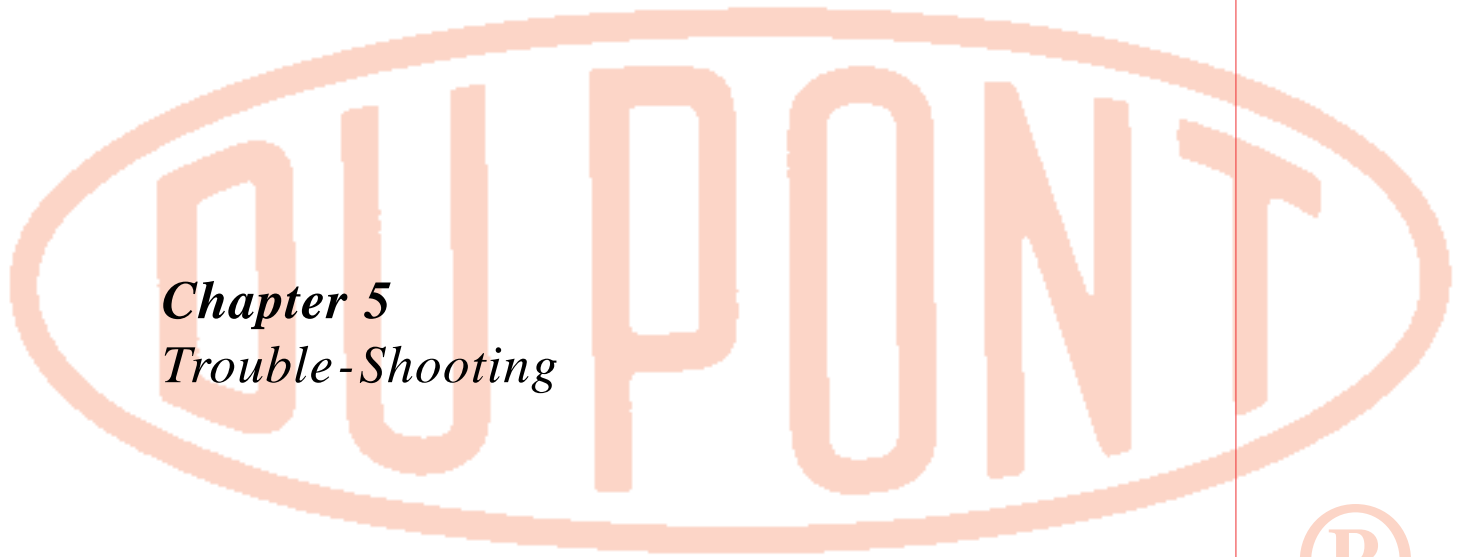
- *Negative and positive lines with a width between 0.25 and 1.00 mm touching at right angles.*
- *Negative and positive isolated dots with a diameter between 0.25 and 1 mm.*
- *Halftone areas with 24 and 34 L/cm and an area coverage of 3, 5, 10, and 90%.*

These test negatives are also subject to the rule that when establishing the required exposure times only those elements of the test negative should be evaluated which are also featured in the customer's negatives.

(The evaluation of the test strips is performed as described in Chapter 4.1.4.2 Standard Test Negative.)

i





Chapter 5
Trouble-Shooting



TRUBLE - SHOOTING

CHAPTER 5

Problems can occur in all processing stages of plate production, including the storage and handling of the raw plates, the original copy, the production of the negative, and the individual steps leading up to the handling of the finished printing plate.

It is sometimes difficult to clearly identify the precise origin of a problem. To facilitate error or problem diagnosis, the plate, the original negative, and a print sample should be available. It is important to record the number of the relevant production run (batch no.) to ensure easy tracking. This number is indicated on the label of each box (e. g. 3219 – 1).

5.1

VACUUM PROBLEMS

Symptoms

- *Unsharp edges in image details.*
- *Irregular line width and type characters.*
- *Shallow reverses (generally in partial areas only), especially in shadow and halftone areas.*
- *Vacuum channels visible on the plate.*

Possible Causes

- *Air bubbles between film and plate. Insufficient or interrupted vacuum during main exposure, caused by lack of, or insufficient film matting.*

- *The negative was positioned with its reverse side on the plate surface.*
- *The protective sheet was not removed prior to main exposure.*
- *No masking tape was used.*
- *The films were excessively heated up during exposure.*

If the entire image area displays these symptoms, this may also be attributable to an overexposure.

SURFACE DEFECTS

5.2

Symptoms

- *Notches in the plate surface, generally accompanied by unsharp edges.*
- *Circular or wavy shadows in solid areas.*

Possible Causes

These problems can be caused by contaminations between the film and the plate, within transparent film areas, by scratch marks in the film, or contaminations on the vacuum sheet. Frequently there are traces of red ochre or retouching paint adhering to the vacuum sheet.

As the raw plate is extremely sensitive to pressure before polymerisation, irregularities in the film, e. g. creases or scratch marks and contaminations between film and plate, are pressed into the plate surface by the vacuum pressure. During exposure, these deformations are then permanently anchored by the polymerisation process.

The same applies to Newton rings, which develop when two very smooth surfaces, e. g. unmatted film emulsion and plate surface, are firmly pressed together.

PARTIALLY IRREGULAR POLYMERISATION

Symptoms

- *Shallow reverses, but sufficient relief depth, generally limited to certain clearly defined areas. Most apparent in text and halftone areas.*

Possible Causes

- *Insufficient negative density.*
- *Differences in sensitivity caused by exposure to oxygen due to partial lift-off of the protective sheet.*

To ensure that the halftone dots are still sufficiently covered, the photographic density in the fully blackened areas of the film negatives should exceed 4.0. In the case of low densities and long exposure times, the exposure may penetrate the black areas of the halftone areas during platemaking, resulting in shallower reverses.

A similar symptom is experienced with such images if a plate is used where the protective sheet had become partially detached from the plate. The oxygen entering between the protective sheet and the plate acts as a decelerant during the main exposure process. The polymerisation effect is less pronounced, and the resulting reverses vary.

In borderline cases, dots may break off, or fine linework may remain wavy.

UNSHARP, WASHED-OUT RELIEF

Symptoms

- *Unsharp, washed-out relief – low overall thickness.*
- *While overall thickness is correct, there is no visible image, or only the contours are visible.*

Possible Causes

- *The plate was exposed from the wrong side.*
- *Back and main exposure were mixed up.*
- *Main exposure was carried out without applying a vacuum.*
- *The protective sheet was not removed prior to main exposure.*
- *Back exposure time was extremely long.*

If main exposure is performed through the backing, no relief is built up on the emulsion side. During the wash-out process, the non-polymerised upper part of the emulsion is removed. An unsharp, poorly defined relief is created on the relief base.

If back exposure was carried out from the emulsion side, this procedure combined with the main exposure results in the full polymerisation of the entire emulsion layer. The image is only barely visible as a contour.

If the protective sheet is not removed prior to main exposure, or if no vacuum is applied, light scatter results in an unsharp, washed-out relief lacking detail.

An extremely long back exposure time prevents wash-out, and the image is visible as a contour only.

5.5

SHALLOW RELIEF DEPTH**Symptoms**

- *The relief base is too high.*

Possible Causes

- *The back exposure time was too long.*

Symptoms

- *A layer of non-washed-out Cyrel® material remains on the correctly polymerised relief base. In this case, the base is normally soiled and greasy.*

Possible Causes

- *The wash-out time was too short.*
- *The wash-out solution was too cold.*
- *Regeneration was insufficient.*

5.6

WAVY LINES, WASHED-OUT DOTS OR HALFTONE AREAS**Symptoms**

- *Fine lines remain wavy after drying.*

- *Isolated dots or halftone areas with highlights have a pitted appearance or are missing altogether.*

Possible Cause

- *The main exposure time was too short.*
- *The details in the film were out of specification.*
- *The combination of back and main exposure was not sufficient to achieve the full polymerisation of the emulsion layer.*

Similar symptoms are experienced as a result of excessively long wash-out times, excessively high temperature of the wash-out solution, or an insufficient alcohol content of the wash-out solution.

MISSING IMAGE DETAILS, POLYMERISATION IN NON-IMAGE AREAS

5.7

Symptoms

- *Lines fully or partially interrupted.*
- *Small dots or lines in non-image areas.*

Possible Causes

- *The source of the problem is most certainly to be found in the negative.*
- *The negative used was not spotted out.*
- *The hard edges of paste-ups were not masked.*
- *The plate edges were not correctly masked by masking foil.*

5.8

UNEVEN, UNCLEAN PLATE SURFACE

Symptoms

- *The print area of the plate surface is soiled, streaked, or smeared. Polymer residue is visible especially in typeface corners.*

Possible Causes

- *Contamination on the plate surface is caused almost exclusively by improper processing conditions.*
- *The back exposure time was too short.*
- *The solvent was too cold, not sufficiently regenerated.*
- *The wash-out time was too short (the unpolymerised raw material was not completely removed from the relief base).*

The wash-out solution accumulates monomers during the wash-out process and becomes viscous. If the plate is not thoroughly washed out, monomer residue will be deposited on the plate surface.

5.9

CRESCENTS, ORANGE PEEL EFFECTS AND DRYING SPOTS IN SOLID AREAS

Symptoms

- *This problem occurs primarily in solid areas, in the area of negative image elements, but also in larger areas featuring typeface and images,*

though only seldom in halftone areas. The plate surface has a pitted appearance and resembles an orange peel.

Possible Causes

- *The main exposure time was too short.*
- *Insufficient regeneration, wash-out times were too long (high temperature).*
- *Insufficient alcohol content in the wash-out solution.*
- *Surface cleaning not optimally adjusted.*

The formation of orange peel effects can be prevented by ensuring that proper wash-out conditions are observed and excess wash-out solution is carefully dabbed off the plate surface prior to drying. Drying spots may appear if the dried or drying surface of the plate is again sprayed with solvent which then is left to dry.

These problems can be eliminated by briefly washing the plate with fresh wash-out solution and re-drying.

Some plate types display a tendency to develop orange peel effects in solids. These effects are normally visible only immediately after washing and will disappear after short drying times.

TACKY PLATE SURFACE

Symptoms

- *The surface of the dried plate remains tacky or becomes tacky again after final exposure.*

Possible Causes

- *The surface of the Cyrel® plate is slightly tacky after drying and does not lose this property until it has completed the finishing process. If the finishing time is too short, the plate will remain tacky.*

If finishing is omitted and the plate subjected to post-exposure only, this tackiness is considerably increased.

However, tackiness may also be caused by ill-suited inks, washing agents and ink solvents, mechanical stress and abrasion during printing.

5.11

LIFT-OFF OF THE BACKING (DELAMINATION)

Symptoms

- *The polymer's adhesion to the backing is insufficient. The layer (partially) lifts off.*

Possible Causes

Incorrect processing.

- *Insufficient back exposure.*
- *Shearing effects during plate cutting.*

Unfavourable conditions on the press.

- *Mechanical stress processes caused by unfavourable printing pressure or by air trapped between the plate and the double-sided adhesive tape.*

CRACKS IN THE PLATE SURFACE

Symptoms

- *The plate surface displays various types of tears and cracks. They may be limited to the image areas, but do also occasionally appear in the relief base.*

Possible Causes

Surface tension is invariably the cause for the destruction of the cross-linked structure. It is generally caused by oxygen, most strongly in the form of ozone. The processing conditions play a crucial role in this context.

Improper finishing (either too long or too short) and exposure to daylight (sunlight) may encourage these symptoms. However, the problem may also be triggered by exposing the plate to aggressive solvents.

Normally, however, the problem is caused by a combination of several different factors. Proper storage will generally suffice to protect the plates. Avoid exposure to daylight and ozone over longer periods of time.



Chapter 6
*Handling of Cyrel®
Plates by the Printer*



HANDLING OF CYREL® PLATES BY THE PRINTER

CHAPTER 6

The Cyrel® printing plate offers you a top-quality product of polymer technology which when handled with proper care will achieve long run lengths and a long service life. While Cyrel® printing plates can help to optimise printing conditions, they cannot eliminate problems caused by mechanical and technical defects in the press. The following recommendations can help to make your daily work procedures easier.

6.1

PREPARATION OF THE PLATES

Providing the available space is sufficient, the plates should be 5 – 8 mm larger on each side than the printed image. When cutting, make sure the polyester backing is not torn; avoid blunt cutting tools.

Cyrel® Cutting Table, standard paper shears, rotary slitters or sharp blades such as those used to cut carpets are suitable for cutting. We will be happy to provide you with a list of manufacturers of cutting tools.

In addition, it is recommended to trim the plate corners and cut the edges at a bevel. An easy method of doing so is illustrated in the following diagram.

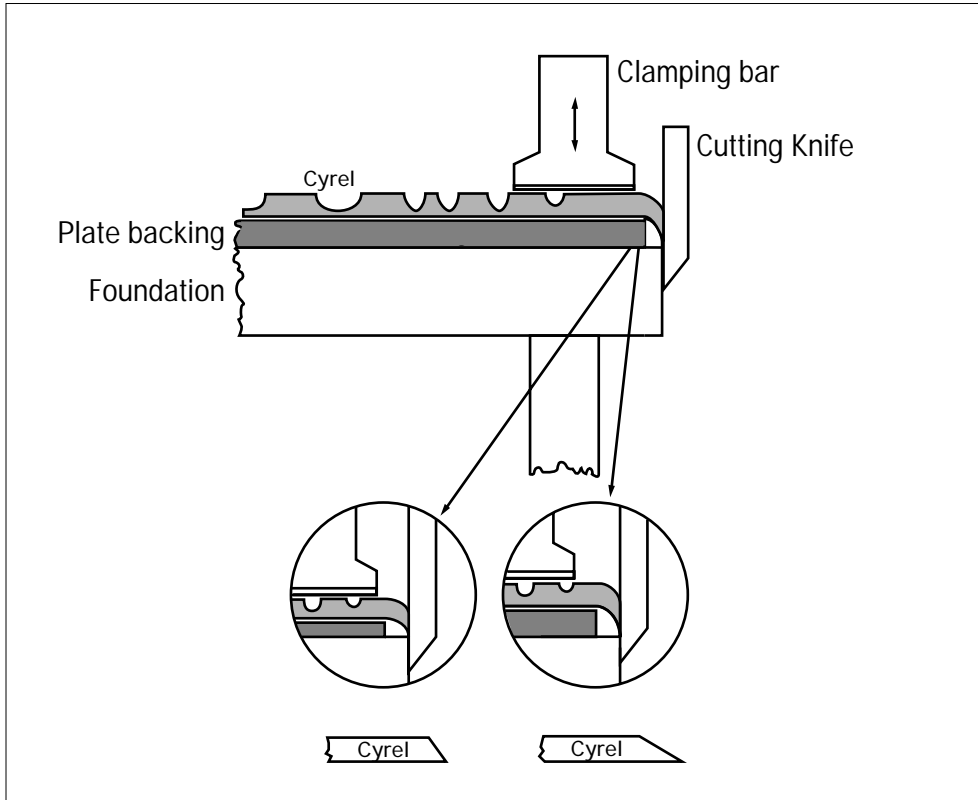


Fig. 16: Cutting the edges at a bevel

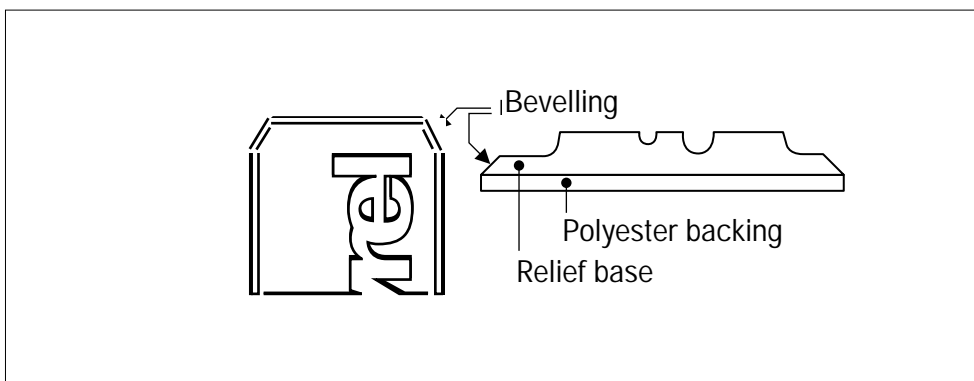


Fig. 17: Bevelled edges

6.2

MOUNTING

The following mounting options are available:

- *Mounting directly onto the printing cylinder.*
- *Mounting on sleeves made of fibre glass, polyester, or nickel.*
- *Mounting using polyester mounting film.*

The plates are generally mounted with the aid of double-sided adhesive tape, e. g. Cyrel® Tape FOL or MONT.

6.3

CLEANING AND STORING USED CYREL® PLATES

One of the tremendous economic advantages of Cyrel® printing plates is their re-usability. This requires regular and proper cleaning and correct storage.

6.3.1

Cleaning the Plates

Careful cleaning of Cyrel® printing plates improves printing quality and ensures a longer service and storage life of the plates.

Cleaning should be performed:

- *At regular intervals during long print runs, when the shadow areas fill in,*
- *During press downtime and after completion of the print run.*

Make sure that no ink is left to dry on the plate surface. It is extremely difficult to remove and, when it cracks, may damage the plate.

During press down-time, make sure the print forme does not remain in contact with the screen roller and the substrate. Due to the quick-drying properties of flexo inks, the plate may stick to the screen roller or to the substrate and be damaged on press restart. The fresher the ink and the earlier the plate is cleaned, the easier it is to ensure thorough cleaning.

Suitable plate washes are all solvents that are compatible with Cyrel®:

- *When using water-based inks, it is recommended to clean the plate with water and small quantities of special plate washes.*
- *When using solvent-based inks, use undiluted ethyl or isopropyl alcohol.*

Commercially available roller washes may only be used if they do not contain aggressive solvents (e. g. acetone, ester, petroleum spirit). Roller washes for offset or letterpress printing are not suitable.

Even brief exposure to such solvents can destroy the surface finishing, later on allowing solvents to penetrate the plate. This may lead to premature plate wear.

If the plate edges are not sealed, please make sure when cleaning the plates on the cylinder that no alcohol is allowed to penetrate between the adhesive film and the cylinder. The adhesives contained in the film are normally soluble in alcohol, and the adhesive properties of the film may therefore be reduced.

To remove dried ink stains, allow the solvent some time to take effect. It is recommended to completely immerse the plate in the wash for a period of time after removal from the cylinder.

Gentle and careful mechanical cleaning of the plate using a soft brush or a lint-free non-woven cloth is also possible. Strong mechanical cleaning procedures on the plate, however, should be avoided.

After cleaning, rinse the plate with fresh plate wash, dab off excess fluid, and leave the plate to air-dry prior to storage. If water is used for cleaning, halftone areas and negative image elements should be blown out with compressed air to prevent the deposit of lime.

6.3.2 Removing the Plates from the Impression Cylinder

Remove edge seals, if any, and beginning in one corner, use a tongue-shaped blunt spatula (do not use a knife!) to remove the plates from the adhesive film parallel to the cylinder shaft. Then peel the plate off the cylinder at an obtuse angle. Alcohol sprayed between the plate and the adhesive film will help to remove the adhesive. After removing the plate, remove any remaining traces of adhesive from the reverse side and from the cylinder surface.

6.3.3 Storing Used Cyrel® Plates

Used Cyrel® relief plates can be stored over longer periods of time and then re-used. They may be stored either mounted on the cylinder or dismounted.

In both cases, the following applies:

- *Clean and dry the plates before storage. Any traces of plate wash may penetrate the plate and reduce the Shore hardness.*
- *During storage, protect the plates from direct exposure to sunlight, UV radiation, and longer exposure to white light (fluorescent lamps or daylight). Light-proof packaging is recommended.*
- *Even though Cyrel® plates are extremely durable, they should not be exposed to high pressure or uneven loads over longer periods of time. Use interleaving made of foam for protection.*

Oxygen, in particular in connection with light, causes the plates to become brittle and fade. Ozone is an especially active form of oxygen and develops near extruders with corona pre-treatment and tends to damage non-ozone-resistant plates very quickly.

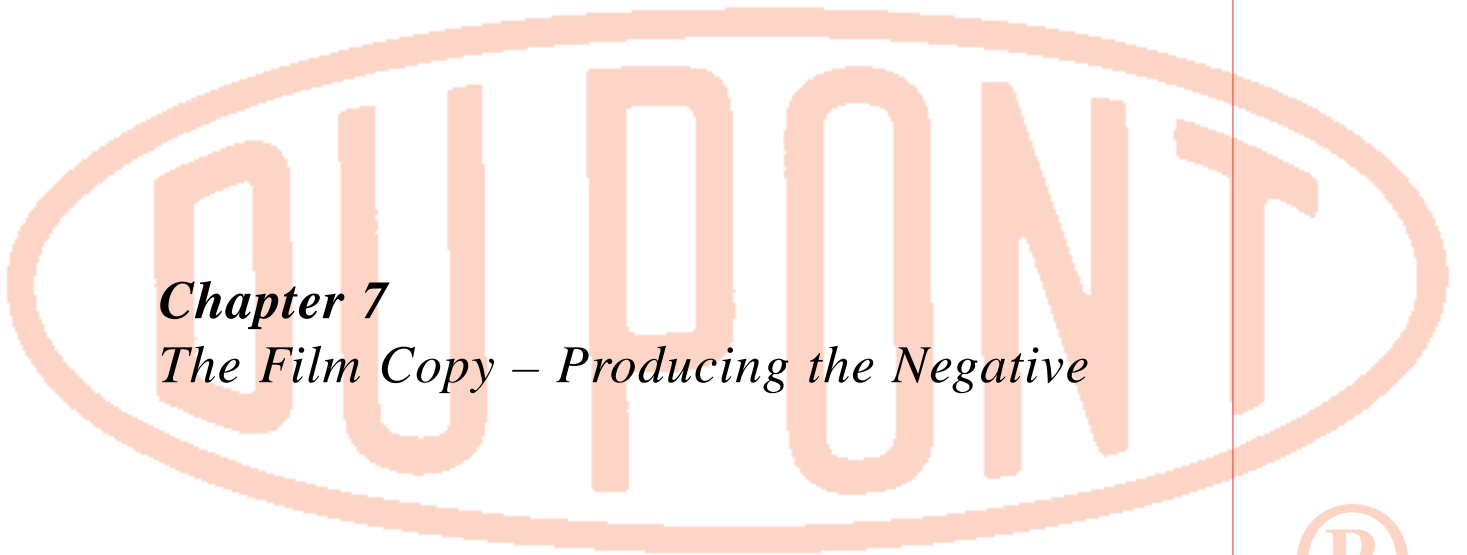
Therefore, demounted plates should be stored in flat, in boxes, kraft paper, or black polyethylene bags. Mounted cylinders should be wrapped in opaque polyethylene film or aluminium foil, the latter of which is ozone-tight.





Chapter 7

The Film Copy – Producing the Negative



THE FILM COPY – PRODUCING THE NEGATIVE**CHAPTER 7**

Flexographic printing is a letterpress printing procedure. The quality of the original copy is crucial to the achievable quality of the printed result. The initial design, the finished artwork, and the reproduction must take into consideration printing parameters such as dot gain, colour density, and transferred ink quantities and allow for compensation as required. Only then will the final print result be a faithful reproduction of the original artwork.

7.1

ORIGINAL – THE FINISHED ARTWORK

The production of a good film negative depends largely – apart from good repro techniques – on the quality of the original. When creating the artwork or selecting the transmission copy, the desired print results should be considered.

- 1. The finished artwork and the text copy must have a uniform density. Foggy or yellowed paper, originals featuring grey shades in different densities require photographic manipulation and time-consuming retouching work in order to achieve a usable negative.*
- 2. To ensure a good reproduction of the reverses, type characters should not be set too closely for negative typefaces. The minimum distance should not be less than 0.75 mm, the type size should be at least be 4 points. Bold typefaces are preferable to standard faces, as they remain open longer during printing, even under stronger printing pressure.*
- 3. Especially when photographically scaling down linework originals, please make sure that the permissible minimum line weight is observed. Otherwise, extremely long exposure times may be necessary during platemaking.*

4. *Screened reflection copy must be reproduced in litho quality. If possible, provision should be made for subsequent reductions in length in direction of print prior to screening and production of the final negative. A subsequent one-sided shortening can be carried out with the aid of special devices. In screened areas, minor deteriorations in quality cannot be excluded.*
5. *Trapping, overlayers, or cut-outs in multi-colour work must be created on dimensionally stable films so as to ensure register accuracy. Contour lines should be wide enough to compensate for minor register problems.*
6. *Crop marks, crosshair marks, contour lines, or other information required for reproduction should be recorded on overlayers. If they are necessary for montage and printing, they need to be transferred to the negative.*
7. *Most materials used in lithography, such as stripping film, masking film, retouching paint, mechanical tints, and litho tapes, are suitable. It is important to ensure that the finished film possesses certain properties.*

SELECTION OF TRANSPARENCIES

7.2

The selection of an impeccable transparency is indispensable for perfect colour reproduction.

The following rule should be observed:



Even superior reproduction techniques cannot create details, colour brilliance, and tonal range lacking in the original.

Please make sure that shadow areas display a good density and that definition in highlight areas is sufficient. A shallow transparency with poor contrast is difficult to reproduce and an enormous challenge with regard to the technical printing conditions and the operators' skills. In most cases, it will invariably produce a low-contrast, unsatisfactory printed result.

7.3

THE NEGATIVE

The Cyrel® process is a negative process. The film copy must therefore be a film negative.

This is significant for the final quality of the print forme. Each Cyrel® plate is an original and can only be as good as the negative on the basis of which it was produced.

The film copy is normally created by photographic means. Linework or halftone negatives with sharply contoured image elements are suitable.

7.3.1

Minimum Density

To initiate the polymerisation process, a certain minimum exposure time is required. As described in Chapter 4, intensive UV tube lamps (UVA radiation) are used for this purpose. If the negative density of the film copy is insufficient, this may result in a shallow relief in the reverses and other image elements. In extreme cases, it may even lead to complete polymerisation, in which case the plate would display virtually no relief at all. For this reason, a film density of at least $D_{\log} 4.0$ is required.

Anti-Halation – Maximum Transparency

7.3.2

The negatives should be fully translucent in the transparent areas (D_{\log} max. 0.03 – 0.05). UV density in these areas should be lower than 0.08. Grey veils absorb the exposure light, requiring longer exposure times. If the remaining veil in the film is too strong, fine image elements – fine lines, highlight dots – cannot be fully developed and will be lost during the wash-out process.

Matted Film Surface

7.3.3

For the exposure step, the film negative must be in contact with the smooth plate surface by means of suction, with all air bubbles removed.

Only films with a matted surface will ensure that the air between the plate surface and the film is extracted without leaving any air bubbles, and that sufficient contact between film and plate is achieved.

Insufficient vacuum or air bubbles will cause side lighting and result in the following problems:

- *Increased size of highlight screen dots.*
- *Tonal changes in halftone areas.*
- *Unsharp edges of the image elements.*
- *Loss of detail in typefaces with fine, sweeping serifs.*
- *Loss of reverses.*
- *Uncontrollable partial widening of lines.*

For the exposure step, the matted film emulsion must always be brought into contact with the smooth surface of the plate.

7.3.4 Page Orientation

Normal surface printing generally requires right-reading negatives. They produce a wrong-reading printing plate and subsequently a right-reading printed image. When printing on the back side of the film (reverse printing), a wrong-reading negative is required.

"Right-reading" = readable from the matt film emulsion side.

"Wrong-reading" = readable from the glossy back side of the film.

7.3.5 Masking the Negative – Retouching

When working with two or multi-colour linework it is frequently necessary to mask individual image elements. But even completely flawless film production may require film corrections. We recommend the use of graphite-based retouching paint or UV-tight adhesive tape. Retouching pens or felt pens should be avoided, as they considerably soil the vacuum sheet. Retouching work should always be performed on the reverse side of the film. Retouching work on the emulsion side may cause vacuum problems.

7.3.6 Correction of Problems in Transparent Negative Areas

Scratch marks on the emulsion side in solid areas and linework lead to a deformation of the plate surface during exposure and are visible in the printed image.

If it is not possible to physically remove the problem, the film may have to be re-contacted. The same applies if there are creases in the film.

Crosshair Marks

7.3.7

Cross-hair marks are an indispensable aid in printing, especially in the case of multiple colour work where sets of printing plates are mounted on the impression cylinders.

The cross-hair marks should be 10 mm long and at least 0.2 – 0.25 mm wide. Finer lines would require much longer exposure times, unnecessarily extending the plate production time.

Please note that if the copy needs to be scaled down, the size of the cross-hair marks must be increased accordingly in the original. To facilitate subsequent mounting, it is recommended to position the cross-hair marks parallel to the image edge, on at least two opposite sides, in the centre of the image. A diagonal position should be avoided.

Checking the Negative

7.3.8

Before committing the negatives to plate production, it is recommended to inspect them carefully to ascertain that they meet the specifications. This should include careful checking for contamination, pinpricks, scratches, edge sharpness of the film details, and sufficient size of the cross-hair marks. Make sure that the film is correctly oriented and has sufficient matting and density.

To check the print image, the correct technical processing (e. g. with regard to trapping, etc.), and the colour reproduction in multiple-colour sets, it is recommended to use the DuPont Cromalin® proofing system.

This inspection is becoming increasingly important also with a view to the use of data media and data communication via ISDN, in which cases there is no original artwork.

Without these prior checks, potential problems may be detected too late (i. e. during the print run).

7.3.9 Properties of the Image Elements

We recommend the use of films directly imaged in a laser film imagesetter. In this type of original, the image elements have sharp contours and largely exclude tonal changes during image transfer.

Negatives produced by optical means in the camera can display problems which may modify the image data during transfer to the plate. This type of negative is therefore less acceptable.

7.3.10 Unsharp Lines or Dots

➔ **Please check for the following problems:**

A magnifier with factor 10 enlargement will suffice to detect typeface or dot edges that are not entirely sharp. These problems will produce rounded edges in the print form and, subsequently, result in an unsharp printed image.

In extreme cases, they can cause what is known as "bolder" print results.

7.3.11 Fringed or Veiled Dots, Insufficient Coverage

These problems are generally attributable to an unsuitable production process of the film negatives. When copying directly to the printing plate, veil effects reduce the UV effect on the raw material, entailing longer exposure

times. Then again, the longer exposure time will cause fringed dots or uns-harp edges, which are simply areas of low density, to be penetrated by the exposure light.

The result is a change in dot size or line width. The subsequent printed image will display tonal shifts or missing details.

Negatives displaying this type of problem need to be reworked, i. e. corrected or re-copied.

Admissible Size of the Image Elements

7.3.12

Provided the Cyrel® plate has been correctly processed, image elements with the following dimensions can be readily transferred to the raw material and subsequently printed without any problems:

- *Isolated lines with a minimum thickness of 0.17 mm.*
- *Isolated dots with a minimum diameter of 0.25 mm.*
- *Highlight screen dots with an area coverage of 2% (48 L/cm).*

Practical experience has shown that even finer image details can be transferred onto a Cyrel® printing plate without any problems. During the subsequent printing process, however, problems cannot be entirely excluded. Flexo printing is a letterpress printing technique with an inherent dot gain depending largely on the printing parameters. Insufficient optimisation or improper handling may cause image detail that is present in the plate to be lost during printing.

To ensure an optimum reproduction of all image details, please ascertain that the settings for printing pressure, inking, printing speed, and ink viscosity are optimised and maintained during the entire print run.

To ensure optimum conditions, it may be necessary to modify the inking units on older presses.

A new development is likely to considerably simplify and standardise the printing parameters: The flexo plates with a relatively thick relief base used in the past will be replaced by extremely thin plates.

Their hard surface ensures perfect edge definition even in extraordinarily fine image elements, with a low dot gain. The necessary compressibility in printing is achieved by a resilient structure on the cylinders. As a result, flexo print characteristics will move closer toward the characteristics of offset printing.

7.4

STRETCHING OF THE IMAGE

If Cyrel® printing plates are exposed in a flat position and subsequently printed on a rotating cylinder, the changing cylinder rolling relationship results in a change in the printed image. In print direction, the image is stretched, while in cross direction the dimensions remain unchanged (see Fig. 17).

The resulting change in length depends on the cylinder size. The image stretch produced when using Cyrel® printing plates is constant and can be easily calculated.

Shortening the Negative – Calculation

7.4.1

A Cyrel® plate exposed in a flat position and subsequently mounted around a cylinder is stretched along its surface by the following constant:

$$K = 2 \times t \times \pi$$

In this formula, "t" represents the thickness of the polymer layer, i. e. the overall plate thickness minus the polyester backing, which normally has a thickness of 0.127 mm (0.005 inches).

This constant always depends on the thickness of the raw material only, and not on the curvature. Therefore it makes no difference whether a large or small cylinder is used.

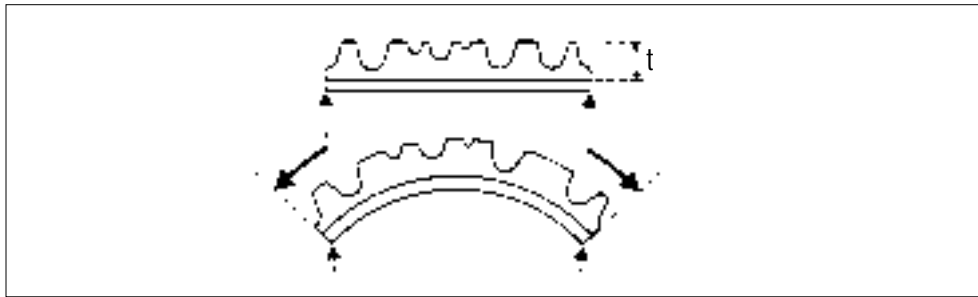


Fig. 18: Stretching of the image

To calculate the required percentage of shortening, the image size needs to be established and taken into account. The best method is to use the print length "R". This value is defined by the distance that a particular point travels on the plate surface during one full revolution of the printing cylinder. It can thus be directly measured on a print sample.

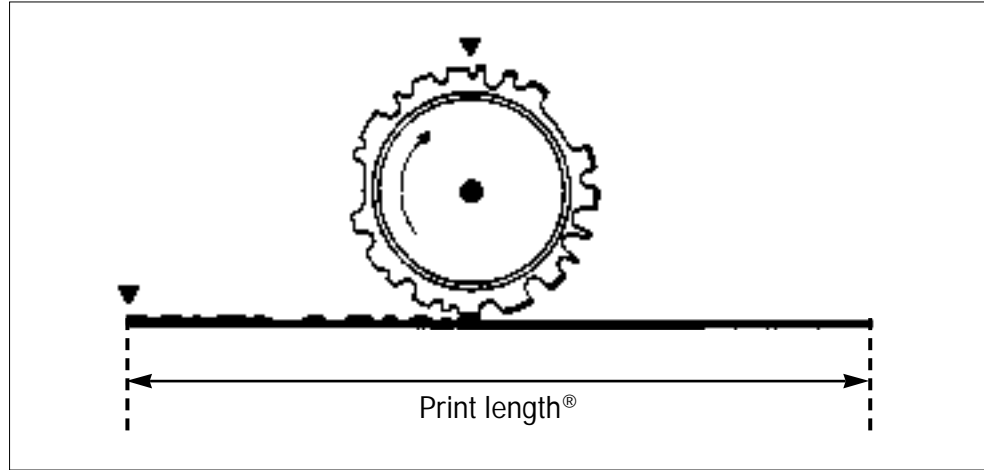


Fig. 19: Calculation of the print length

A calculation is also possible if the following values are available:

cylinder diameter
 + 2 x adhesive tape thickness
 + 2 x plate thickness

 = overall diameter x

The required shortening of the original copy in percent is then calculated on the basis of the following formula:

$$\% \text{ shortening} = \frac{K}{R} \times 100 = \frac{\text{Constant}}{\text{Print length}} \times 100$$

This is the value by which the length of the original must be reduced in print direction. In other words, an existing original must be reduced in print direction from 100% to the following value:

$$\frac{R - K}{R} \times 100$$

The following constants are valid for the various Cyrel® plate types:

Cyrel® Plate Type	K1 (Inches)	K2 (cm)
CL 2	0.126	0.245
CL 4	0.220	0.559
30*	0.144	0.367
45*	0.239	0.606
67	0.390	0.990
90	0.534	1.357
100	0.597	1.516
107	0.641	1.628
112	0.672	1.708
125	0.754	1.915
155	0.943	2.394
170	1.037	2.634
185	1.131	2.873
197	1.207	3.064
217	1.332	3.384
237	1.457	3.700
250	1.539	3.910
255	1,571	4,004

7.4.2

Practical Example

On an impression cylinder equipped with a Cyrel® plate type 112 PLS, which produces a print length of 30 cm, a printed image with the dimensions 24 x 30 cm is required. The image length is in print direction and should equal 30 cm when printed. By what percentage must the negative be shortened ?

Calculation:

$$\% \text{ shortening} = \frac{K}{R} \times 100 = \frac{1.708}{30} \times 100 = 5.69 \%$$

The negative must therefore be shortened by 5.69% in print direction.

The new negative length is calculated as follows:

$$30 \text{ cm} - 5.69\% = 30 \text{ cm} - 1.7 \text{ cm}$$

New film length = 28.3 cm

Another method of calculation is the following:

$$\frac{R - K}{R} \times 100 = \text{negative in \%}$$

$$\frac{30 \text{ cm} - 1.708 \text{ cm}}{30 \text{ cm}} \times 100 = 94.3 \%$$

The new film length is therefore:

$$\frac{30 \text{ cm} \times 94.31 \%}{100 \%} = 28.3 \text{ cm}$$



Chapter 8
Cyrel® Wash-Out Solutions



CYREL® WASH-OUT SOLUTIONS**CHAPTER 8**

8.1

PLATE TYPES

Cyrel® flexo printing plates can be washed out with different wash-out solutions. The conventional wash-out solution for photopolymer flexo printing plates used to be a mixture of the chlorinated hydrocarbon perchloroethylene and the alcohol butyl alcohol.

The end of the eighties saw an increasing demand for the development of non-toxic alternatives for environmental and health reasons, as chlorinated hydrocarbons are suspected of causing cancer in humans and are virtually non-degradable in nature. For these reasons, DuPont developed the alternative wash-out solutions OptiSol® 737, FlexoSol®, and UniSol®.

i

A special brochure is available on the alternative wash-out solutions.

8.2

CHARACTERISATIONS

Today, DuPont Cyrel® offers three alternative wash-out solutions whose specific properties cater to the different operating requirements:

OPTISOL®

OptiSol®, developed in 1989, was the first alternative wash-out solution produced by DuPont for use in in-line processors.

FLEXOSOL®

The wash-out solution FlexoSol® has an especially mild odour. FlexoSol® can be used in all Cyrel® in-line processors.

UNISOL®

The special strength of the wash-out solution UniSol® is that it can be used at room temperature and offers short wash-out times. UniSol® is particularly suited for drum and Perc-Inline processors.

* OptiSol® and FlexoSol® require a wash-out temperature of 34 °C. A cooling/heating unit is therefore necessary.

All three DuPont wash-out solutions are subject to the regulations on combustible liquids (VbF, class A III).

Emissions are much lower than the statutory threshold values laid down in the technical regulations for waste air, class III. A special cleaning system for waste air is therefore not required.

COMPOSITIONS

- *OptiSol® is an ester/alcohol compound.*
- *FlexoSol® and UniSol® are hydrocarbon/alcohol compounds.*

8.3

SAFETY AND PRODUCT INFORMATION

	Per/ Butonol	OptiSol®	FlexoSol®	UniSol®
Boiling range (°C)	109	165–198	80–215	157–215
Flash point (°C)	43	67	56	63
Regulations on com- bustible liquids (VbF)	A II	A III	A III	A III
Inflammation point (°C)		>200	230	445
Explosion limits (percentage by volume)	4,5–20,5	0,6–7,0	1,0–6,1	1,1–6,5
Density (g/cm ³)	1,42	0,86	0,85	0,91
Technical regulations on waste air (class)	I	III	III	III
Mass flux (limit)	0,1 kg/h	3 kg/h	3 kg/h	3 kg/h
Waste air concentra- tion (limit)	100 mg/m ³	no limit < 3kg/h	no limit < 3kg/h	no limit < 3kg/h
Odour threshold (vol. ppm)	20	< 0,5	20	5
Device emission	1000- 8000 g/h	*200- 680 g/h	**310- 680 g/h	***459- 568 g/h
Water hazard class	3	1	1	2
Toxic substance code	x _n	0	x _n	0

* at 30 °C wash-out temperature

** at 34 °C wash-out temperature

*** at 22 °C wash-out temperature

0 not subject to labelling requirements

Notes

8.4.1

When used properly in accordance with their intended purpose, UniSol®, FlexoSol®, and OptiSol® present a minimum hazard to human health and the environment. Safe handling of these substances is subject to the binding regulations governing solvents.

Please observe the following safety recommendations:

Delivery

8.4.2

On delivery, please make sure that the wash-out solution is supplied in suitable and undamaged containers. The chemical dealer is obliged and willing to take back damaged containers.

Make sure that the containers are sealed tight and are neither damaged nor rusty.

Storage

8.4.3

The storage of transport containers is subject to additional safety measures. This includes the installation of sheet steel drip pans in the appropriate size. DuPont Cyrel® alternative wash-out solutions and their distillates must be frost-protected during storage.

If ...

8.4.4

... wash-out solution collects in the drip pan, it must immediately be bound with suitable absorbing agents (e. g. UNI-SAFE by ÖKO-TEC) and properly disposed of.



Please set up suitable rules of conduct to be followed in the event of damage. For further information in this context, please refer to the safety data sheet.

8.4.5 Ductwork and Processors

Ductwork and hoses are subject to special safety precautions: They must be clearly visible and inspected at regular intervals. The ground underneath the ductwork must be protected against leakage. Processors should be placed in drip pans of the appropriate size.

8.4.6 Unit Modifications

Modifications of processors that may become necessary depend on the type and status of the unit in question.

The status of all Cyrel® processors available on the market is registered. Modification details are available from your Cyrel® field service.

8.4.7 Loss of Wash-Out Solution

The emissions produced during the processing operation in Cyrel® processors are much lower than the values specified in the technical regulations on waste air, class III.

PROCESS DATA

	OptiSol®	FlexoSol®	UniSol®	Per/ Butonol
Composition	Ester/ Alcohol	Alipihat. KW Alcohol	Aromat. KW Alcohol	CKW/ Alcohol
Wash-out temperature	34°C	34°C	20–24°C	20°C
Wash-out time (sec)				
Cyrel® 67 PLS	430	350	230	210
Cyrel® 112 PLS	430	350	230	210
Cyrel® 115 TDR	900	740	500	450
Cyrel® 185 TDR	900	740	500	450
Drying time (h)	2	3	3+	1,5–2
Odour	strong	mild	moderate	moderate
Unit modification	In-line unit (heating)	In-line unit (heating)	In-line unit (cooling) Drum processor	In-line unit (cooling) Drum processor
Distillation	Vacuum continuous	Vacuum in batch	Vacuum in batch	Normal pressure in batch



8.5.1

Notes

The indicated values are average values and need to be tested individually.

The wash-out times should be kept as short as possible to avoid unnecessary swelling.

In order to achieve uniform wash-out results, it is crucial to maintain a constant wash-out solution temperature.

8.6

DISTILLATION – GENERAL INFORMATION

DuPont Cyrel® alternative wash-out solutions can be distilled without any problems in most commercially available vacuum-based distilling units, such as the M 20 unit manufactured by Renzmann.

Vacuum distillation offers the following advantages:

- *Low pressure causes a low boiling point.*
- *The wash-out solution is subjected to lower thermal loads.*
- *Energy consumption is dramatically reduced, operating costs are lower due to vacuum stages.*
- *Emissions during draining are also considerably lower.*

OptiSol®, FlexoSol®, and UniSol® have different distilling properties.

Distillation of OptiSol®

The boiling points of the individual OptiSol® components differ only marginally, thus allowing for a continuous distillation process. The composition of the mixture can be checked by the following procedure:

Description

This method is based on a separation of the acetate with potassium hydroxide and subsequent back titration of the excess potassium hydroxide with hydrochloric acid.

Chemicals

- *0.5 N potassium hydroxide solution in 2-propyl alcohol.*
- *0.5 N hydrochloric acid or sulphuric acid.*
- *Alcali blue 6B, 0.04 %/O in methanol.*

Handling

The first solution is produced as follows:

Dissolve the required quantity of potassium hydroxide in water-free 2-propyl alcohol (dried with CaO p. a.). The solution must be effectively protected from CO₂ and water.

The sample to be analysed can either be used as such or dissolved in 2-propyl alcohol (if necessary in 2-propyl alcohol/toluol 8 : 5) and mixed with the amount of propylic KOH required for max. 85 percentage by weight of acetate. This is then heated in a 300 ml conical flask with a return condenser for a period of approx. 15 minutes at 100 °C. 20 drops of alcali blue are added to the solution while still hot (70 °C), after which titration with the acid is performed until a colour transition from reddish brown to brownish olive green is visible.

The end point is reached when the transition remains stable for a period of at least 10 seconds.

The following formula can be used to determine the percentage by volume of acetate of the solution:

$$\frac{(0.5 \times a - N \times b) \times 15.5}{E} = \text{acetate percentage by volume}$$

a = millilitres prop. KOH.

b = millilitres acid used.

c = normality of acid.

E = originally weighted-in quantity of the sample in grams.

An acetate content of 69 ± 3 % by volume is acceptable.

An alternative to titration is a GC analysis. It is recommended to observe the following requirements for a GC analysis:

Capillary column:

Macherey & Nagel - 50 m OV1,

0.31 mm external diameter

Injection:

1 µl, dilution 1:100
(methanol)

Temperature

Injection:

250 °C

Oven:

70 °C 5 min. isothermal
10 °C/min. up to 280 °C

Detector:

FID

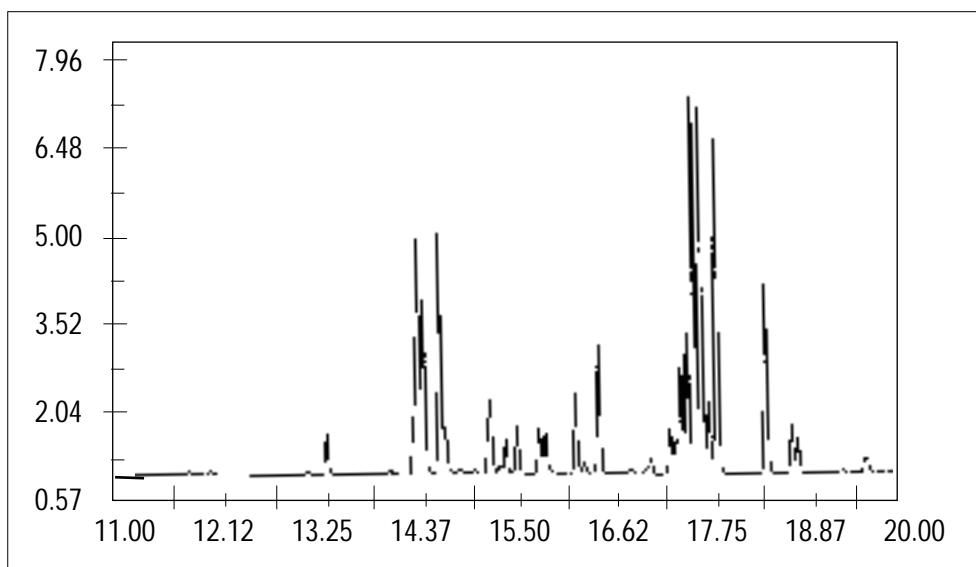


Fig. 20: OptiSol® gas chromatogram

Sample: Study of March 23, 1994, 2nd Inj.

Analyzed: Fri. May 13, 1994 1:211 : 30 pm

Result: / DATA / RAHN / RESULT / OPTISOL® 035. RES

8.6.2

Distillation FlexoSol®, UniSol®

When distilling FlexoSol® and UniSol®, the individual constituents separate in different ratios of components. Therefore, it must always be ensured that the complete batch is distilled and vigorously mixed (batch distillation) prior to extracting the wash-out solution. Here, too, analytical checks of the regenerated solution over longer periods of time do not reveal any major shift in the ratio of components (provided the regeneration rate is sufficient).

For both wash-out solutions, it is recommended to check the composition of the distillate after every 5 distillations. This simple and quick procedure is described below:

Description:

100 ml distillate and 100 ml reagent solution (currently in preparation) are mixed well (shaken, stirred) in a 250 ml cylindrical vessel. After approx. 5 minutes, the mixture is separated into 2 bands. The volume of the lower band is measured - cloudiness has no effect on the result. If the volume thus established is within the following ranges:

- *109 – 112 ml for FlexoSol®*
- or*
- *115 – 122 ml for UniSol®*

an antistatic agent is added to the distillate as required (see page 13). After vigorous stirring, the distillate is ready for use. If the measured volume deviates from the values specified above, please communicate this information to the Cyrel® field service.

Distillation Conditions

8.6.3

The distillation of all three wash-out solutions is performed in a vacuum at 100 mbar (900 mbar below normal pressure).

The following data refers to the Renzmann distillation unit:

	OptiSol®	FlexoSol®	UniSol®
Oil temperature (°C)*	175		180
Safety temperature (°C)	125		130
Shut-down temperature (°C)	120		125
Boiling temperature (°C)	115		120

*General oil temperature is 30 – 60 °C higher than boiling temperature.

ANTISTATIC CONDUCTANCE ENHANCER

8.7

The conductance of flammable wash-out solutions should be at least 10,000 pS/m to prevent the build-up of an electrostatic charge during the wash-out process. After distillation, it is necessary to add an antistatic agent to UniSol® and FlexoSol® and mix well.

OptiSol® does not require an antistatic agent.

Quantities of antistatic agent to be added to UniSol® and FlexoSol®:

Distillate (quantity in litres)	Antistatic agent (volume in ml)
100	30
200	60
300	90

8.8

DISPOSAL

All DuPont Cyrel® wash-out solutions are chlorine-free compounds of esters or of pure hydrocarbons and alcohols.

They are not subject to the chlorine surcharges normally payable for the disposal, for example, of distillation residues containing perchloroethylene.

The disposal of wash-out solutions via waste water is prohibited! The public sewage system is not designed for wash-out solutions.

The disposal of distillation residues and cleaning cloths is subject to the regulations on toxic waste. The applicable waste code in Germany is 59703. This applies to solvent-based distillation residues without halogenated hydrocarbons.

According to HIM (Hessische Industriemüllverbrennungs GmbH, an organisation of the state of Hessen, Germany for the incineration of industrial waste), these residues are ideally suited for incineration on account of their thermal value.



Appendix

Checklist

Are your employees familiar with the handling regulations for the wash-out solution used, in particular with a view to hazards to human health and the environment?

Are your employees familiar with the procedures to be adopted in case of emergency? Whom do they need to inform?

Are suitable absorbant materials and protective devices available for emergencies?

Can your storage facilities be checked for leaks, and are they regularly inspected with a view to impermeability?

Are the containers transported and stored in suitable drip pans?

Are they stored in an area equipped with drip pans? Are these pans made of approved materials? (If necessary, a certificate of compliance with water pollution requirements should be procured.)

Can ductwork and hoses be inspected, and are they equipped with protective devices?

Are your waste materials recycled?

Do you store your empty containers with the same care as full ones?

Are the containers for used wash-out solutions in an impeccable condition?

Are chlorinated hydrocarbons still in use? Do your facilities still comply with the increased requirements on the use of chlorinated hydrocarbons?

Could you reduce the use of chlorinated hydrocarbons in your facilities?

Are ductwork/containers/drip pans equipped with a CHC-resistant coating?

Are waste air filters installed – are they serviced at regular intervals?

Are you familiar with the amount of CHCs emitted with waste air and disposed of with waste materials?

Does your facility produce waste water containing CHCs? Is it treated adequately?

Are waste materials containing CHCs disposed of as toxic waste?

Do you know whom to contact if problems should arise?

Do you know where to obtain further information?

Have you spoken to your insurance company?



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Issue Date: January 1998

Design, Typesetting

atelier für gestaltung und kommunikation – niesner und huber, Wuppertal