microPrint
SWITZERLAND

The pad printing book

Content

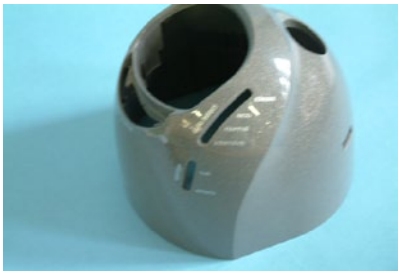
1 General Background - The Process Entry

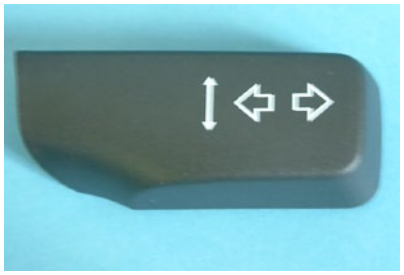
Since the late 1960's an old printing method, which had been particularly well established in the watch-making industry, has been experiencing an unexpected boom. Pad printing was discovered for newer, broader applications and with the help of silicone pads and new machine constructions it truly blossomed. Pad printing machine manufacturers sprung up like mushrooms and satisfied the real market need for printing and decorating parts in a simple and inexpensive way.

Pad printing allows new designing possibilities for engineers and designers and as a result, the products are becoming more attractive and functional.

Today, pad printing has reached a technical advanced state and the range is quite diversified. This technical brochure aims at giving an overview illustrated with microPrint pad printing machines. It is also meant as an orientation guide for the daily problems and questions of experts.

1.1 Typical Pad Printing Examples



1.2 History

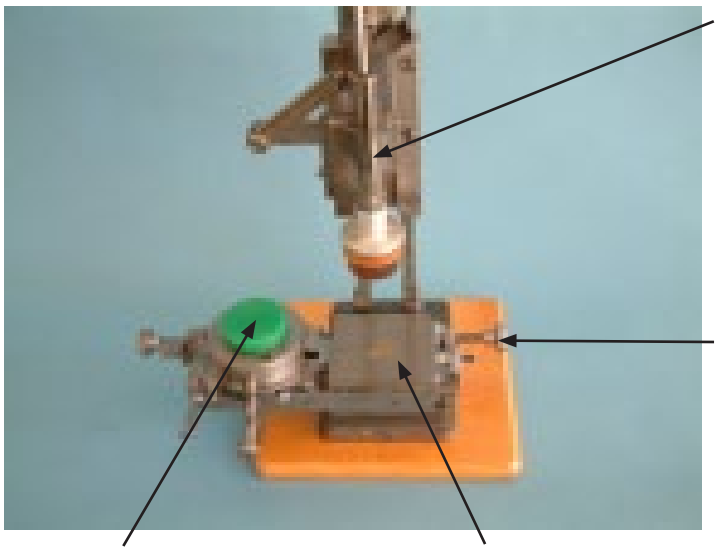
Most likely it will remain a secret who invented pad printing. The roots of this printing method lay in the watch-making and ceramics industry.

The watch-makers of the Swiss Jura and the Black Forest started out painting in their clock faces with paintbrushes. This was extremely time-consuming. Over time these clock faces decreased ever more in size. Subsequently, the paintbrushes followed this trend which ended in the use of a single bristle. With this bristle and a magnifying glass true works of art were created. Samples can be seen in the watch museums, especially the watch museum in La Chaux de Fonds, Switzerland. The scripts became so small that the normal eye could no longer read it. Entire bible passages and maps were imposed on the fancy watches. It is said that the artists who achieved these work of art turned into eccentrics due to their concentrated working. Despite detailed research of the watch museum in La Chaux de Fonds, they were not able to determine when the transition to pad printing, i.e. the repro-

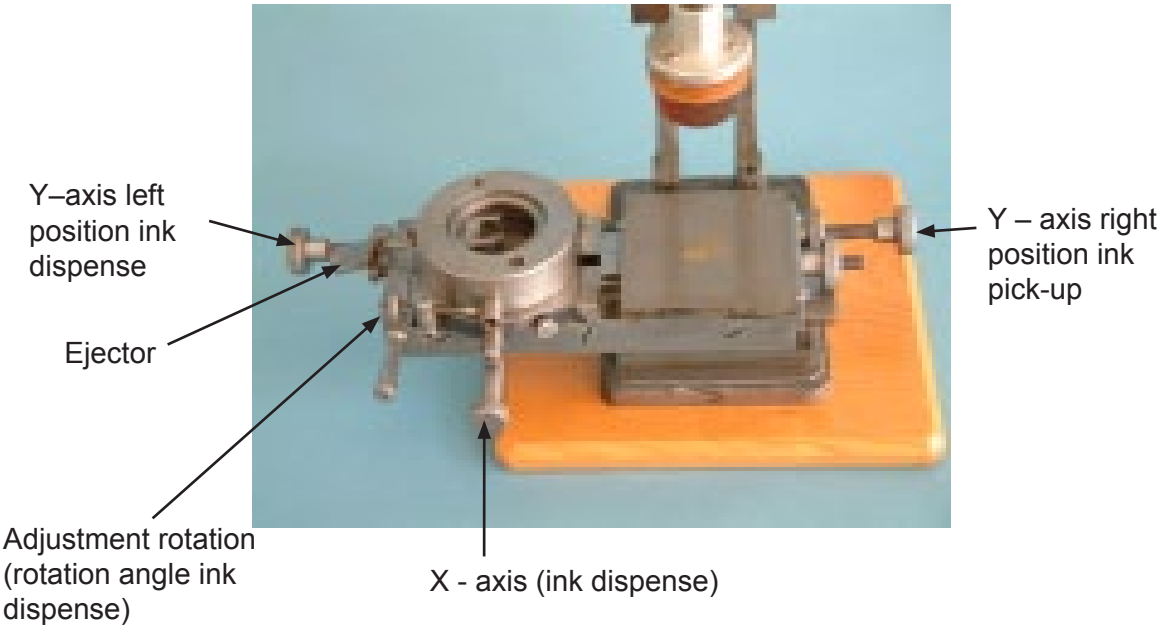
duction of once engraved pictures took place. However, it is certain that precursors of this machine were used as early as the 18th century.

The first pad printing machines

Based on these first machines the process is easily explained. The construction of these machines was quite simple. They were equipped with horizontal and vertical carriages. Both carriages were operated manually. The vertical carriage was held up by a spring.



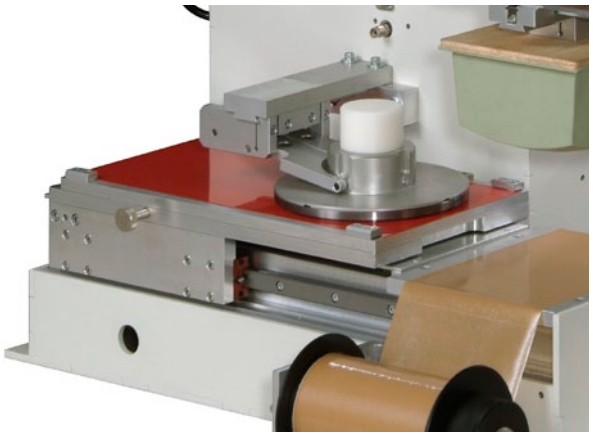
Each pad printing machine must have the option to precisely adjust the position of the print. The first pad printing machines already had all of these adjustment options, just like today's modern machines do.



As already mentioned you will find all of these adjustment options in today's machines as well. An interesting advancement is the microPrint Module machine.

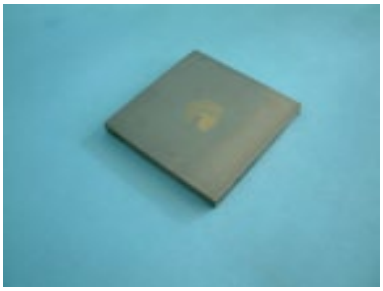
The microPrint Module machine can be mechanically adjusted through stepper motors.

This means that the machine can be set up 100% via the touch screen. The great advantage is that all important print parameters can be electronically saved and re-accessed.



Cliché carriage can be adjusted via the touch screen X-Y-R +/- 5mm.

1.3 The Process



The print motif was engraved (nowadays etched or leached) approx. 0.024mm deep into the cliché.

In the starting position the cliché was directly under the pad.
The cliché and the retainer for the part to be printed were mounted on the horizontal carriage.

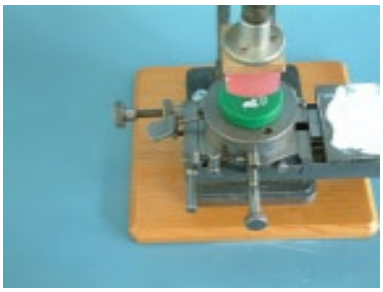
The printing operation was commenced by applying paint to the cliché with the help of a scraper.

Then the excess ink was removed with the scraper. Some ink remained in the inkwell of the cliché, which corresponded to the print image.

Now the print image was transferred to the pad by pressing the pad on the cliché and then raising it again.

Then the horizontal carriage was moved manually to the right so that the part to be printed was positioned under the pad.

With another stroke movement the print image was now transferred on the part to be printed.



This completed the print.

With the help of the scraper the cliché had to be covered again with ink.

This description shows that it required some skills to operate these machines. Special care was given to the preparation of the pads. The gelatine pad (made out of bone meal) was preformed in a casting form. The printing surface was heated with a flame and turned upward. While cooling off a very shiny, nice surface was formed. The surface was so sticky that an ink transfer was only possible after the print surface was powdered. The powdered pads could then transfer approximately 20 excellent ink prints on a turpentine basis. The composition of the powder and the ink used to be guarded trade secrets.

At that time the printing process was not called pad printing but steel engraving. The profession of engraver, who manually engraved the clichés into the copper or iron plate, and the „decalqueuse“, the woman who operated the machine, arose from this.

2 Pad printing today

Compared to the method described in the historical section not much has changed. The basic procedure has remained the same.

Changes pertain to:

2.1 Ink

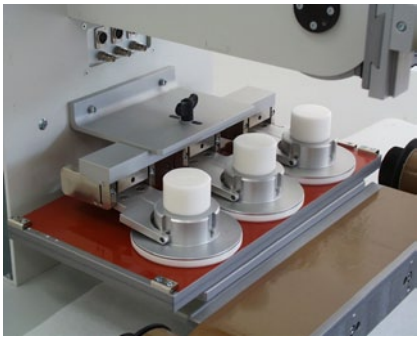
The inks used today are no longer based on turpentine but on quick-drying screen print inks, specifically designed for pad printing.

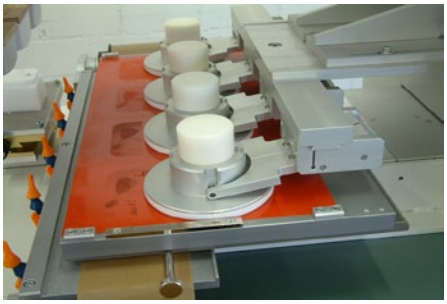
2.2 Open Ink System

The ink is no longer transferred manually to the cliché and the excess removed. The open system uses a doctor blade to transfer the ink and remove the excess. Of course this process is fully automated.

2.3 Closed Cup Ink System

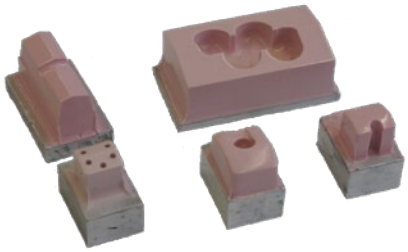
The closed system consists of an inverted cup with a doctor ring. The doctor ring is made either of hard metal or ceramics and has the task of removing excess ink from the cliché. The cup is filled with ink and simply dragged over the cliché. Cup systems have become widely accepted today. The advantage is that the ink is completed sealed in and needs much less maintenance.





2.4 Pad

Today's inks cannot be transferred with gelatin pads. Nowadays, practically all pads are made of silicone rubber. Silicone has the great advantage of absorbing and dispensing inks very well.



2.5 Machine Drives

Recently the drive mechanisms of pad printing machines have changed extensively. From manual operation of the past to normal motors with cam disks to pneumatics with servo-drives we have now reached the stage of linear motors. The choice of drive depends primarily on the application.

Simple pad printing machine with pneumatic drive

Pad printing machine powered by linear motor

2.6 Process Flow and Peripherals

Each process has a „window“ in which the process flow takes place. This applies also to pad printing.

- Ink can only be transferred properly within a certain cliché depth
- Ink can only be transferred within a certain evaporation speed frequency
- Ink can only be transferred within a certain viscosity range
- Ink can only be transferred within a certain ink transfer period
- Printing is only successful within a certain ambient temperature range
- Printing is only successful within a certain humidity range

Each of these parameters can be influenced through other parameter changes. (See also chapter Typographic Remarks).

Only the following 3 green points can be influenced by the machine:

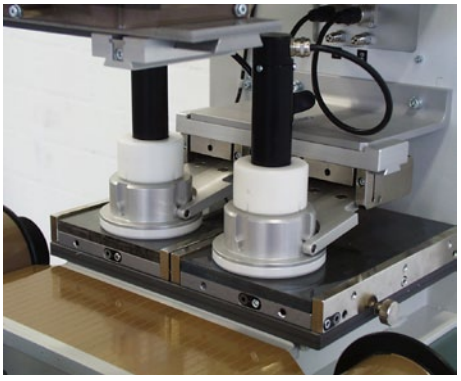
- Ink can only be transferred within a certain ink transfer period
- Printing is only successful within a certain ambient temperature range
- Printing is only successful within a certain humidity range

Subsequently, microPrint has developed the following peripheral devices:

2.7 Viscomat

The viscosity of the ink is extremely important for the print. With an open system you had to stop the printing process every 30 to 40 minutes to dilute the ink. With a cup system this interval is much longer, but even here the solvent evaporates through the movement of the cup on the cliché.

To avoid this problem microPrint developed the Viscomat. It measures the viscosity in the cup and adds solvent as needed.



The Viscomat show the viscosity values on the touch screen with which they can be adjusted. Another touch screen menu can display the viscosity flow as a bar chart. This is very helpful when trying to locate malfunctions.

The Viscomat has two other major advantages:

Due to the continuous stirring (inks are thixotropic) and the stability of the viscosity, the cup-time of 2-component-inks can be extended by 8 to 12 hours (see also Inks).

There are inks with pigments which drop to the bottom of the cup (for example gold or silver colors). The Viscomat prevents this and guarantees the consistent mixing of the ink.

2.8 Machine Cycle

- Ink can only be transferred within a certain ink transfer period

The importance of the cycle for pad printing is easy to understand if you are aware of the theory of ink transfer:

When we start the printing process, ink which is on the cliché is scraped off by the doctor blade. The ink which remains on the cliché, and which corresponds to the print image, contains solvents which evaporate making the ink film on the surface stickier.

Once the pad is placed on the ink surface the ink sticks to the pad.

When the pad is lifted off the cliché, the same happens to the pad. The free ink surface emits solvents and as a result becomes stickier than the ink layer which adheres to the pad. If the pad is transferred to the part to be printed the ink layer sticks to it.

Ideally the pad dispenses all ink.

You can conclude in reverse:

If the cycle time is too high, it can happen that not all or not enough ink is transferred.

If the cycle time is too slow, it can happen that at the time of dispensing the ink is too dry and cannot be transferred.

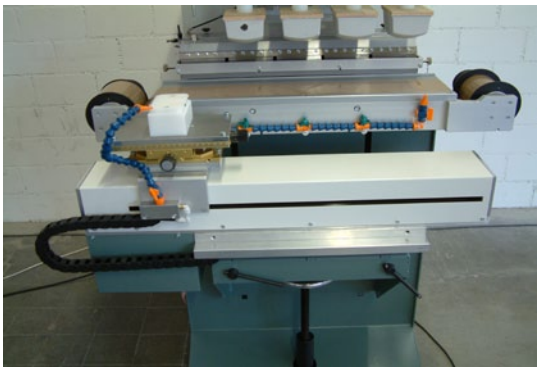
The printing image also influences the ink transfer. Very fine, detailed marks need to be transferred quicker than very large surfaces.

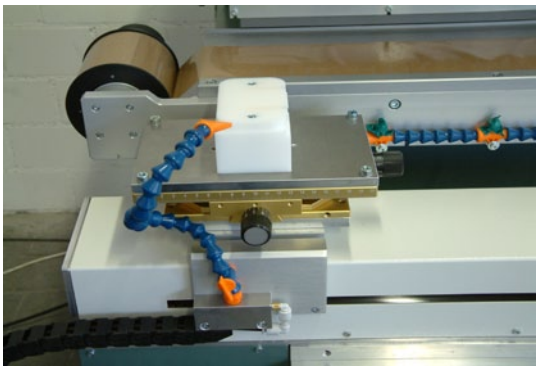
There are three ways of managing the ink transfer periods:

1. Adjusting the machine speed. All microPrint pad printing machines can be easily adjusted through the controller. Ink intake and dispensing can be delayed.

2. Choosing a slower or quicker solvent.

3. Air is blown on the pad to promote evaporation. This method is frequently employed to optimize ink transfer. Air is also blown on the part to be printed for multi-color prints, so that the ink layer is made as sticky as possible.





2.9 Ambient Temperature

- Printing is only successful within a certain ambient temperature range

The ambient environment strongly influences the viscosity and the evaporation speed of the ink.

Ideal printing temperature is at 20° Celsius. If the temperature rises in summer to 30°C or if the printing machine is located in a hot room (foundry), is it recommended to keep the cliché at a temperature of 20° with the aide of a cooling unit. microPrint offers cliché cooling units couplings for all machines.

Cooling unit C10

2.10 Automatic Pad Cleaning

Pads may become soiled with ink, with dirt from the part to be printed or by attracting dust particles from the air.

Therefore a pad must be cleaned from time to time. The cleaning of a pad requires a lot of care. The quality of the print surface directly determines the quality of the print.

Improper cleaning of this surface may destroy or strongly reduce the life of a pad.

Machines with automatic pad cleaning do not have to be stopped for cleaning and the staff does not need to work with cleaning detergents which means an environment-friendlier work place.

The pad life of machines with automatic pad cleaning is no longer dependent on the skills of the operator. Life is extended many times and as a rule waste is drastically reduced.

microPrint has integrated pad cleaning in all of its machines.

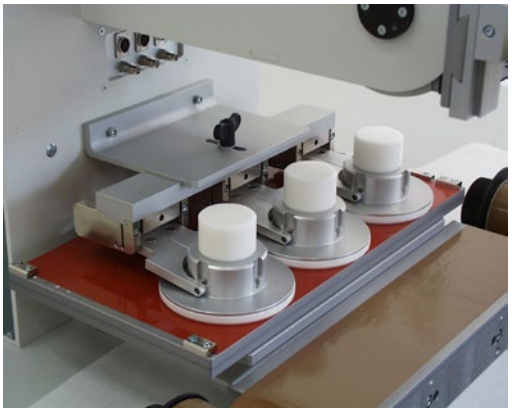
Pad cleaning with open ink system

Pad cleaning with closed ink system

3 Machine systems

Usually the type of application decides which machine system to use. A basic question remains always: open or closed system?

3.1 Open or Closed System



Closed System

Open System

Most people prefer closed systems. The advantages are convincing. The ink is sealed into a cup and therefore very easy to maintain and environmentally sound. Yet there are also compelling reasons to select an open system.

1. The print image is too large and cannot be covered with a pot.

2. Cliché costs – The clichés of closed systems need to be twice as large as those for open systems.

3. There are special inks which can only be used in an open system.

For these reasons all microPrint pad printing machines can be used either open or closed. Changing over from an open to a closed system or vice versa takes only a couple of minutes and requires no technical knowledge.

3.2 Classification machine systems

microPrint Smart Series

is a simple inexpensive pad printing machine for newcomers to pad printing.

microPrint LCN Series

is the machine best suitable for the integration into existing fully-automatic lines with every modern option such as automatic pad cleaning and automatic viscosity and cliché temperature control.

Pneumatic driven

microPrint MS Series

is a conventional machine series, however it comes with every modern option such as automatic pad cleaning and automatic viscosity and cliché temperature control.

Pneumatic driven

microPrint LM Series

is a conventional machine series, however with every modern option such as automatic pad cleaning and automatic viscosity and cliché temperature control.

Electro-mechanic drive with linear and servo-motor.Through pad offset with a linear motor individual lines of the cliché can be accessed and multi-color prints can be performed. All parameters can be saved on a PC and accessed when needed.

microPrint 5star

With the development of our 5 color pad printing center 5star, micro-Print has set a new standard. With a single intake 5 colors can be printed, each color individually and optimally programmable.

microPrint Selecta

Our Selecta have individual characters which can be printed upon demand. The entire alphabet and special characters can be recalled and make this machine a pad printing typewriter.

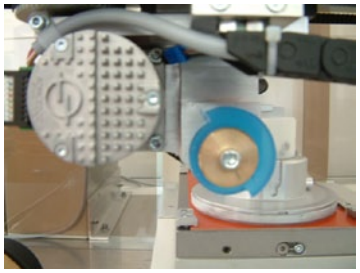
microPrint Modul

is the machine best suitable for fully automatic production.

The machine can be equipped with a professional bus connections with which all parameters (machine adjustments plus print positions) can be entered.

microPrint Module 100 110 130 200 Series

is the machine line for fully automatic manufacturing. The machine possesses optionally a BUS connection about what all parameters (machine attitudes plus print positions) can be adjusted. The machines are very fast and can take up different pictures on the Y-axle and deliver to different positions. The Pad cleaning tape can be fully used.

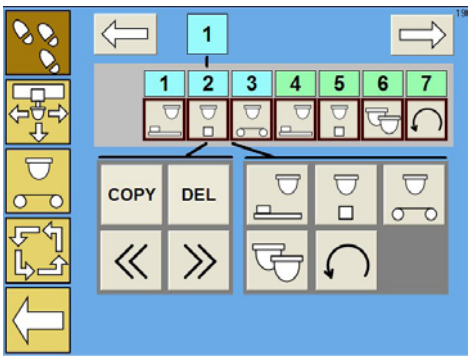


microPrint Round Printing Systems

The MS padprinting machines series can be equipped with various round printing devices.

ML 350 with Robotic System

Pad printing machine for printing multi-colored,sophisticated printing goods in one single operation



easy programming

Modul 100

Modul 110

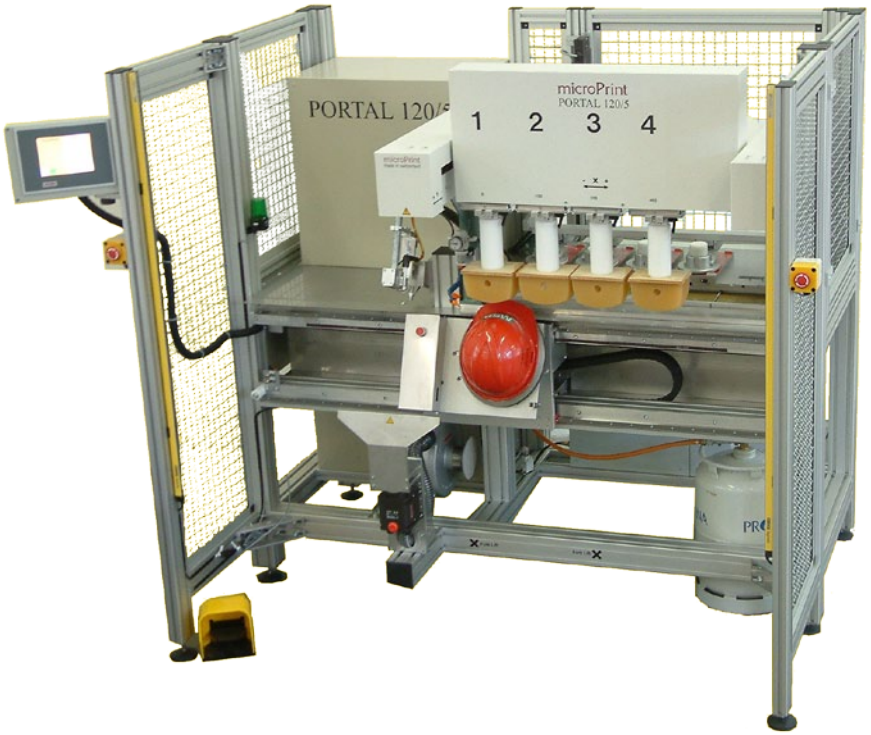
Modul 130

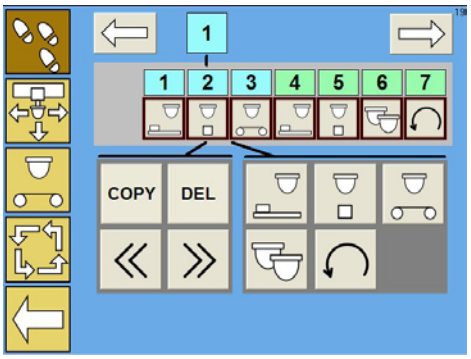
Modul 200

Modul 200

Modul 200

Portal 120/5





easy programming

4 Automation

4.1 Components

To solve a pad printing task optimally you often need to employ additional peripheral units.
These can include:

- Components for indexing table
- Pad transportation units
- Pad shift units
- Round printing units
- With simple traversing table and rotary print part receiver
- With round pad and servo-drives for all print movements
- Print part pick-and-place system
- Vacuum print part retaining and ejection system
- XY cross tables
- Indexing tables
- Traversing tables
- Drying units
- Hot air drying
- Infrared heater
- Flash heater
- Synchronized drying system
- UV – drying
- Cleaning units
- Components for indexing table

4.2 Components for indexing table

The indexing table has fully established itself as an automation component, also in the pad printing industry. Similar to a Lego block you can pick and choose entire indexing table units very easily with the Rotaprint system.

The core is made up of the central table with the indexing table
You can mount any additional tables and fixtures on any side and still move them around.

Auxiliary table for pad printing machines MS 130, MS 250

Auxiliary table for pad printing machines LCN 130, LCN 150

Auxiliary table for pad printing machines MSS 130 (adjustable in height)

Unloading and Loading Handler

Hot air spot drying

Corona pre-processing

Loading units

Safety light barrier

Control in modular design for controlling:

Indexing table, pad printing machine, handing units, pre- or post processing, loading units and light barrier systems

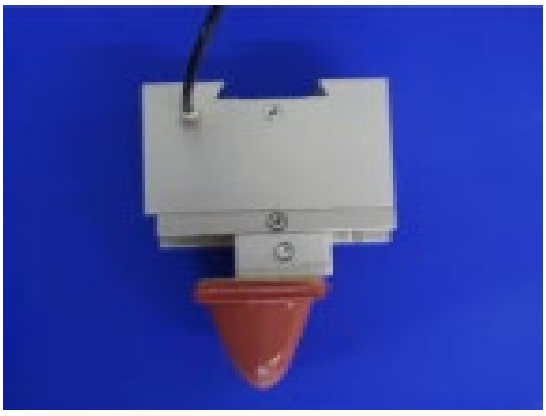
4.3 Pad transportation units

In special cases transporting pads can solve a printing problem in an elegant and simple way.

1. For multi-ink-print, if the print part is very large
2. For different print combination without any retooling
3. If the surfaces to be printed have different heights

Transportation element not extended

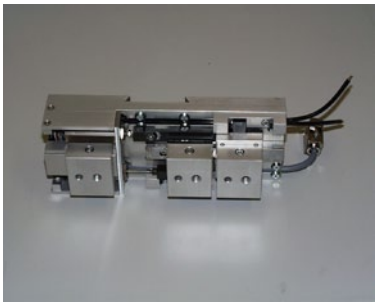
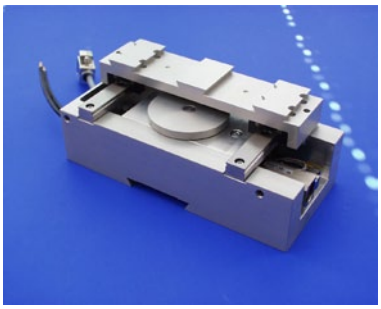
Transportation element extended



Transportation element as an independent module
Can be mounted to practically any microPrint MS pad printing machine

4.4 Pad shift units

In other special cases it may be better to take up a print image on a small surface and to print it in a larger format. This means that texts may be printed further apart than the sizes of the ink pot would allow.

4.5 Round printing units

All pad printing machines of the MS line can be equipped with round printing units. There are two systems available:

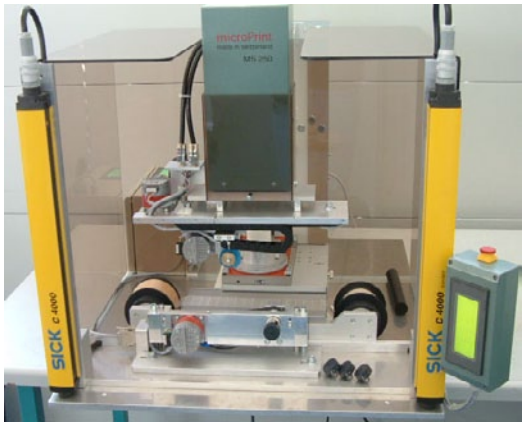
4.5.1 With simple traversing table and rotary print part pick-and-place system


Print part

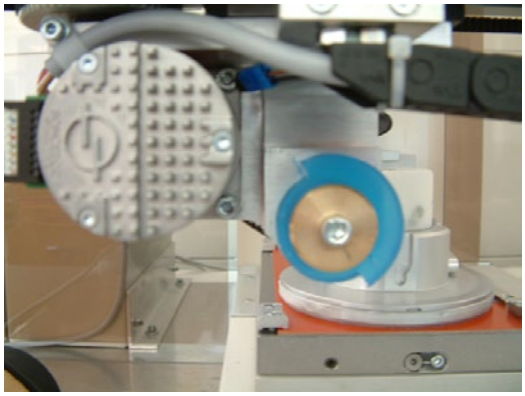
Then the pad moves downwards onto a fixed stop. The traversing carriage moves sideways and the print picture is transferred on the round body which moves.

4.5.2 With Round Printing Pad and Servo Drive for all print movements

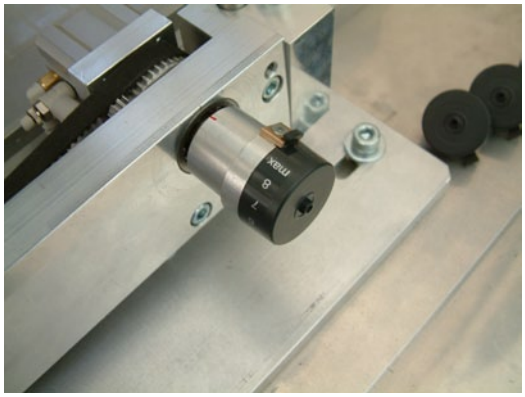
For round printing with high registration a Servo Drive and Round Printing Pad are required. The pad picks up the design (Ink) through a controlled turning movement from the cliché and will transfer it the same way onto the part.



MS 250 with precision Round Printing Equipment and Light Guards



Servo driven Round Printing Pad



Servo driven Holding Fixture with Auto Eject

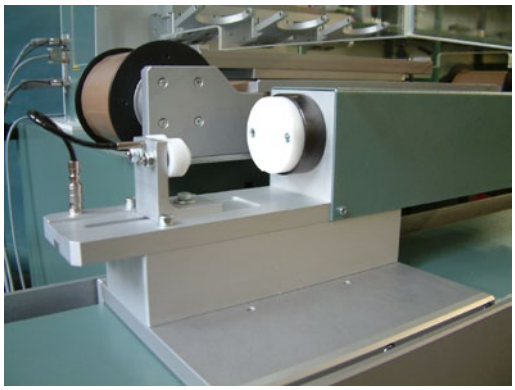
Printed part

4.5.3 Round Print Machine for Printing Multi-Ink Individual Pictures on a Round Body.

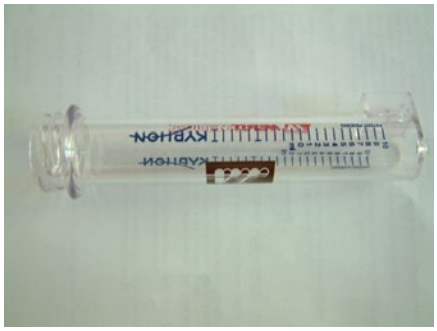
With this machine, simple programmable individual pictures can be transferred and programmed to be printed on a round body on any desired location.

MS 350L with precision round print device
Pad horizontal stroke with linear motor

Servo-driven shift table



Print part holder with programmable rotation



Printed part

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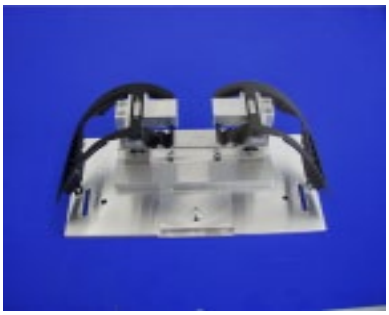
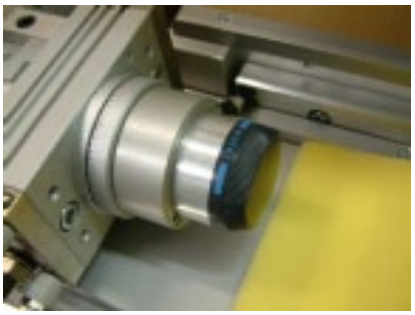
4.6 Print part pick-and-place systems

Print part pick-and-place systems have to fulfill high specifications. On the one hand they must position and fix the print part securely; on the other hand the loading and unloading must be simple and quick.



Double pick-and-place system for an auto part

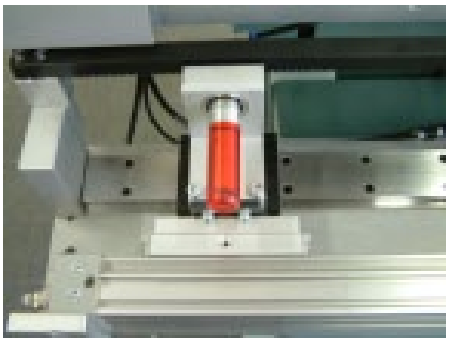


Rotary pick-and-place system for a two-ink-print

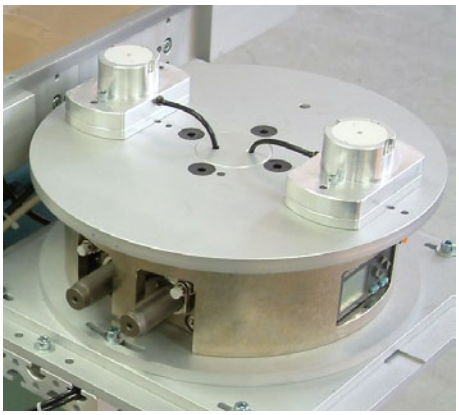
4.7 Vacuum print part retaining and ejection system

Print parts, in particular for multi-ink prints, must be held securely in position. This can be achieved through a spring or pneumatically. Very often the parts are also held with a vacuum and then released with a blast of compressed air.

For this purpose microPrint has developed the following system:



Vacuum Retaining and Compressed Air Rejection Unit VEB2



4.8 XY cross tables

XY cross tables are used to position the print part on the respective pick-and-place unit.

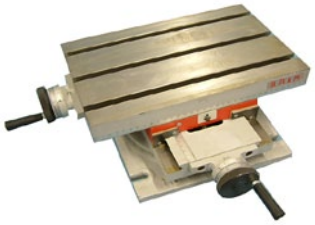
C0 - Mini

C2 - Standard

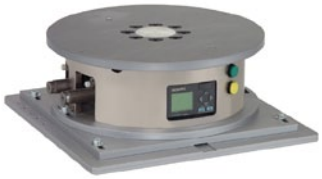
C8 - Universal

C4 - Heavy

C4 - Heavy

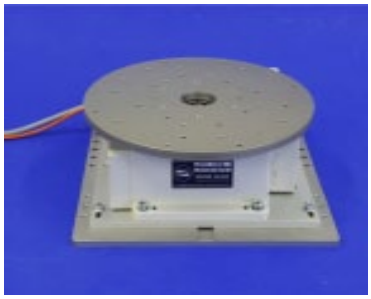


4.9 Indexing tables



Rotary 180 °

You can increase the capacity by using Rotary tables where printing and loading can take place parallel.



Rotary table with 2 - 4 - 6 - 8 positions, depending on application.

With the help of indexing tables you can solve both simple and complex printing problems. Indexing tables are employed primarily when additional functions are required (pre-treatment, drying, placing and ejecting)

4.10 Traversing tables

Traversing tables are used primarily in multiple or multi-ink prints. There are 1 or 2 Axis traversing tables often combined with a rotary device.

X – Axis traversing table 500

X - Y traversing table 500

Traversing table with linear motor and programmable tilting device

X - Y traversing table with light barrier safeguard

4.11 Drying units

Approximately 70% of the wet ink consists of thinner. After printing the thinner must be extracted from the ink film. Due to the relatively thin film, pad prints dry spontaneously on the surface.

It may become critical if several ink layers are to be printed over one another. The solvents of the last printed ink infiltrate into the lower ink layers and soften them again. Solvent dispensing on multi-layer inks is obstructed and significantly slower as on a single layer print. Therefore you need to make sure that the final drying in multi-layer prints is especially thorough.

However, as the ink film in pad printing is relatively thin you still have the possibility to print several inks wet on wet.

As the method of drying can affect the final stability of the color, it is important to choose the most suitable drying method for each application.

The following drying methods are suitable:

1. Hot air drying
2. IR heater
3. Flash heater

4.11.1 Hot air drying

An inexpensive method of drying is with hot air. In most cases this is enough. It is best if these units are synchronized. This prevents the entire unit from being heated. By operating on a synchronized basis or by deflecting the air during breaks you may work with higher temperatures. The hot air treatment, which is also known as Thermodiffussion, operates at 350°C. At these temperatures a 2-component-ink will stick well on polyethylene.

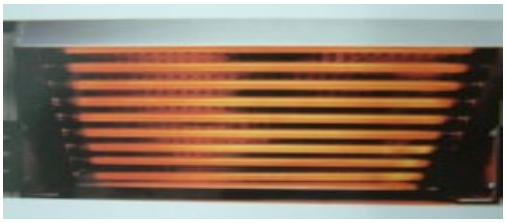
Hot air blow dryer

Adding air on a specific spot prevents that the surrounding area is heated too much and provides heat where it is needed.

4.11.2 IR heater

Infrared heaters transmit large energy masses within a short period of time. Infrared heater are available in many spectrums. Short-wave infrared radiation penetrates the material deeper; middle-wave radiation is absorbed more on surfaces and thin layers.

IR heaters are usually used in plants and drying channels where large quantities and/or large sized parts with large prints need to be dried. The operating heat and time can be adjusted optimally.



Infrared drying oven

4.11.3 Flash heater

Flash heaters are infrared heaters in a wave range between 800 and 1200 nm. In this range the polymers behave transparent, i.e. not the heat conductivity determines the time for the energy transmission, but the radiation penetrates deeply and causes volume heating. This means that during the drying of the ink the entire ink film is heated and dried at the same time which can lead to a significant improvement of ink stability.

A further major advantage of this type of drying is that the printed parts are completely dry for further processing. This means they can be stacked immediately and they do not stick together as bulk goods.

Flash heater for larger surfaces

Flash heater for spot surfaces

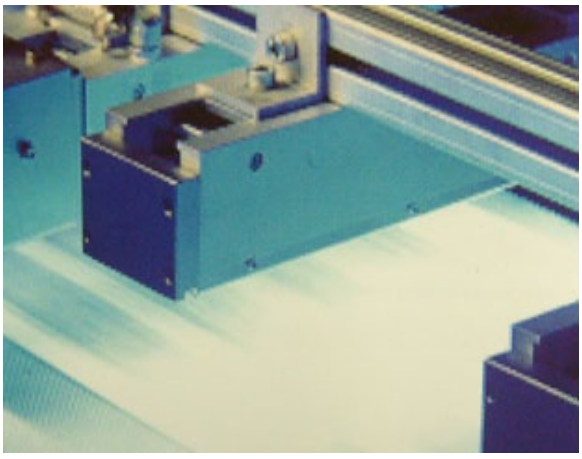
4.11.4 Synchronized drying system

In most cases the print parts are placed on a conveyor belt and moved through a drying channel, after which they then fall as bulk goods into a container. If there is the danger that the parts are damaged, this type of drying is not possible. An additional person would need to remove the parts and deposit them carefully.

In order for one person to work alone (printing and depositing) microPrint has developed a drying system which operates synchronously. It is made up of an indexing table which works synchronously with the printing machine and can be equipped with hot air, IR or flash heater.

4.11.5 UV drying

UV inks are inks which only dry when radiated with ultraviolet light. Over the past couple of years they have become more and more popular. Head models are available which can be mounted to the unit as well as continuous dryers made up of conveyor belts and UV heads. The power of the UV light must be adapted to the individual application. For safety reasons UV light must always be covered very well.



UV head heater

UV heater with conveyor belt

4.12 Cleaning unit

To date there were no cleaning units on the market for cleaning pad printing utensils, such as ink trays, clichés, etc. which fulfilled the ecological and economic aspects optimally.

The use of solvents (thinners) is very common. The disadvantages are diverse. As some of the ink mixes with the solvent, the cleaning effect is very short-lived. This means that the cleaning medium must be replaced frequently. The disposal costs and fees are also aspects which cannot be neglected.

Modelled after nature

The ecocleaner employs the effects of surface and interface tensions for an eco-friendly, highly efficient cleaning system.

Surface tension made visible.

Imitated by us

The ecocleaner is a revolutionary new cleaning system for pad printing utensils. You no longer need to use harmful thinners. The cleaning medium is eco-friendly. There are no more dangerous vapors. Therefore the unit doesn't even need a special cleaning room.

The unit works with two separate zones. Using the correct settings and if properly loaded the parts are cleaned 100%.

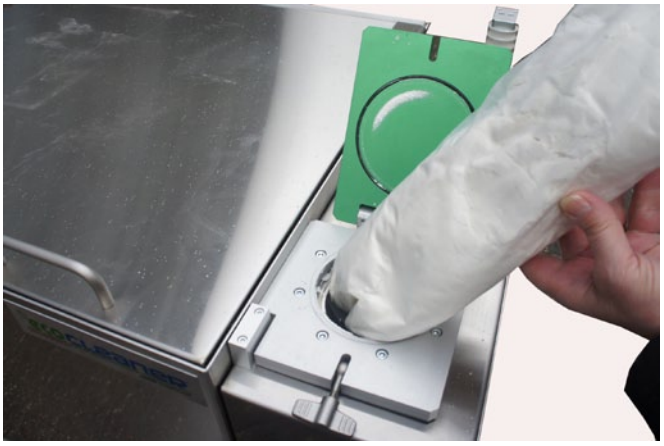
And it doesn't even matter if you use 1 or 2 component colors. Fully hardened 2 component inks may take a little longer to clean

Recycling

The ecocleaner has its very own recycling system. The whole cleaning cycles takes about 30 minutes. Then the entire cleaning agent is transported to its recycling system and cleaned. You can also clean and recycle parallel to the cleaning cycle.

The released ink is collected in an absorber and removed.

After loading the basket the operator does not come in contact with ink!



The same cleaning agent is used over and over again. Refilling only necessary for loss due to dispersion.

ecoCleaner 740

5 Clichés

The cliché is the carrier of the print image. For each new motif a new cliché is needed. The print image is etched into or washed out of the cliché. The etching depth for steel clichés ranges between approx. 0.018 – 0.025mm, depending on the type of application. As the pad can only transfer a limited quantity of ink, a deeper depth would not make sense. Given an etching depth of 0.025mm the pad only takes on approximately 0.012mm ink film; the rest remains in the depression of the cliché. As the ink film is made up of about 40% thinner, which evaporates during transfer and drying on the print parts, a 0.008m ink layer will effectively remain on the print part.

5.1 Clichés Types

Depending on the various requirements such as precision, service life, exchangeability and price, various systems have prevailed. A rough classification based on service life is as follows:

steel clichés	1 000 000
Sheet metal clichés	200 000 - 300 000
Plastic cliché	20 000 - 50 000
Ceramics	(k. A.)
Anodized aluminum foil	40 000
Chrome-plated brass foil	100 000

5.1.1 Steel clichés

Steel clichés are primarily used where precision (scales, miniature trains, gages, etc.) or large quantities are required. A steel cliché consists of hardened steel of approx. 64 Rockwell. The used surface is ground and lapped to roughness class N*. There are inks which attack normal tool steel. If you cannot use an alternative ink which does not attack the steel, you need to select a tool steel which is based on chrome.

5.1.2 Sheet metal clichés

Recently sheet metal clichés have become more important. Their market share has increased significantly and they can be used in many applications. You can punch holes into sheet metal, which can be used for precision positioning. Sheet metal clichés are made of specifically manufactured sheet metal with a surface grade in lap quality N3. The hardness is approx. 49 Rockwell.

Service life ranges between 200 and 300,000 prints, depending on the type of application. The coating, exposure and etching process is identical to that of steel clichés. However, it must be kept in mind that the etching behaviour is different. This is particularly important when you work with a steel grid. Some cliché manufacturers offer clichés which are already coated.

5.1.3 Plastic clichés

Plastic clichés are the most common clichés used today. Depending on the adjustment of the machine they can be used for up to 100,000 prints and more. Plastic clichés need to be differentiated between those which can be rinsed in water and those which can be rinsed in a mixture of alcohol and water. The latter plastic clichés have a harder plastic coating. This type of cliché will give you a better print quality. Criteria for the life cycle of plastic clichés are 1. the doctor knife and 2. the contamination of the ink with fixed particles which are transferred by pad from the print part to the ink.

Plastic clichés are manufactured as follows:

5.2 Cliché making

5.2.1 Film

For all cliché types you need a proper positive film (layer on the bottom). The print image is made on the computer and then printed over a film exposure unit. Already during the making of the film you can influence the print results. Only with a faultless film will you get a good cliché and print picture. Often you will need to expose a grid in the film. The number of grid points per cm² as well as the % values of the grid will determine the later depth of the cliché in plastic clichés.

The design of the motif is practically unlimited. However, you should not go below a font size of 0.3 mm and a line thickness of 0.08 mm. The film should be matted on the contact side, so that the film can be properly vacuum-treated during exposure. To avoid underexposure the film layer must always touch the cliché.

Why a grid?

Given large surfaced prints the ink pot or the ink doctor can dip into print picture (figure 1). Subsequently, the ink is not evenly distributed on the cliché. During ink take-up the pad displaces even more of the ink layer due to its rolling movement (figure 2), so that there is no regular print image during the ink transfer. To prevent this from happening large print surfaces receive „grids“. (This grid has the same function as the grid in gravure printing). In large print fields little cone stumps remain after etching / washing, which have the following benefits:

- The doctor is reinforced through the small circular areas. It therefore cannot dip in and take on too much or irregular ink. The grid cones retain the ink in a regular fashion (figure 3).
- The pad is supported by the small surfaces and cannot displace any ink (figure 4).
- The color ontake is even and subsequently also the area print

Fig.1

Fig.2

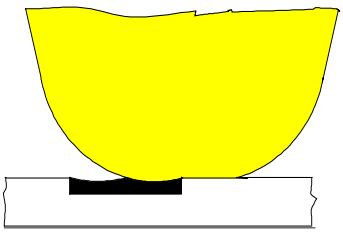


Fig.3

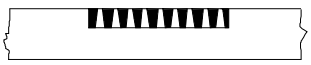
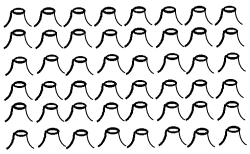


Fig.4



If print surfaces with grids are to be printed very precisely and without saw tooth effect, the print sections of the layout must have an outline. This means that the grid of the print section does not reach to the edge, but that the edge is formed by a line, a groove in the cliché.

5.2.2 Film specifications

Compared to screen printing the copy film on the film layer side must be matted for an optimal vacuum. The matting specifications for master copies for exposing BSAF photopolymer clichés are:

Max. roughness depth Rt >3.5 um

Average surface roughness according to DIN Rz (DIN) >2.7 um

Average roughness Ra>0.2 um

For the optical density the same specifications as for screen printing apply: d>_3.5 (T>_ 0.03%)

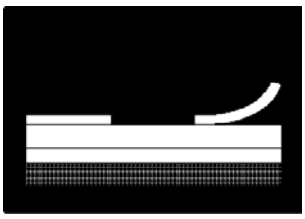
5.2.3 Films for Four-Color-Reproduction

For pad printing an ink shade extent of between 7 to 70 percent, a screen ruling of 80 lines/cm and a round point form is recommended. There are no standard profiles available for producing the film. You usually work with a plastic cliché for first drafts. Should you need varying etching depths you will need to use a steel cliché for the final motif.

5.2.4 Making steel or steel metal clichés

Steel and steel metal clichés are made as follows:

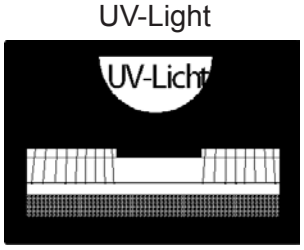
1



Contact with Positive Film

Remove protective foil carefully. Place steel cliché into the exposure unit and position positive film on underdeveloped cliché. Use positive films with an optical density of more than 3.5 log. Before exposing, make sure that film and cliché are free of dust.

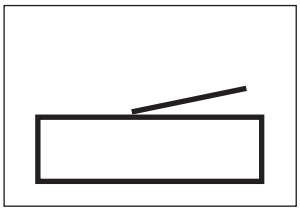
2



Exposure

Close vacuum cover and switch on vacuum. As soon as there is a vacuum, switch on exposure. Length of exposure: 60 to 90 seconds. (Exposure units are available from us)

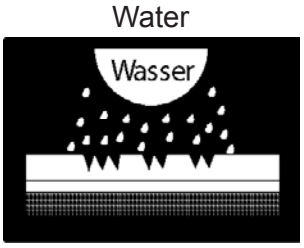
3



Develop

Develop cliché in a tray for approx. 120 seconds.

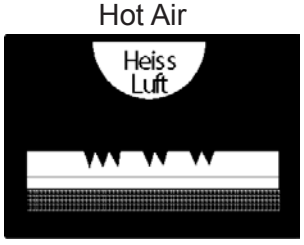
4



Rinsing

Rinse cliché with a soft water spray. Non-exposed areas are rinsed out.

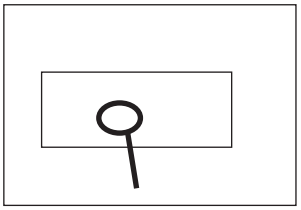
5



Drying

Carefully use compressed air on the cliché to remove all residues and dust particles from the print image. The cliché is then dried with warm air. Drying time: 5 minutes at 60° – 90°C

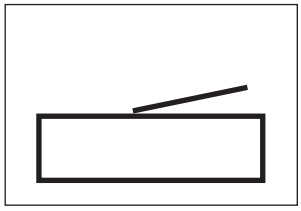
6



Inspection

Visually inspect the photo. If needed correct small mistakes with masking varnish.

7

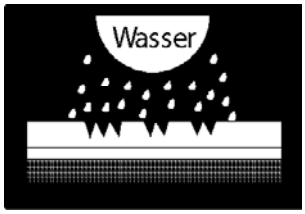


Etching

Switch on etch bath or machine and wait until operating temperature is reached (approx. 38°). Set machine timer (to receive an etch depth of approx. 80% it will take about 120 seconds). Place cliché in the etching machine and activate or move cliché in the etch bath.

Water

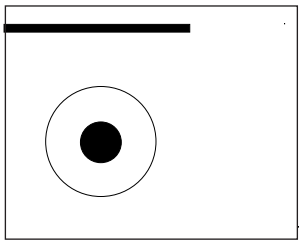
8



Rinsing

Rinse cliché with a soft water jet and dry with a blast of air.

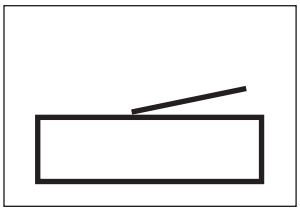
9



Inspection of etch depth

Measure etching depth with mechanical or optical gauge. Depending on the results return to point 7 to re-etch.

10



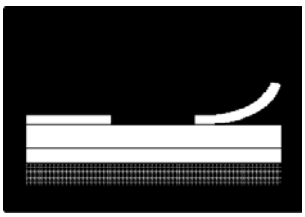
Removing layers / cleaning

Remove layer with special liquid and clean. The clean cliché should be lightly oiled so that it does not oxidize. Wrap cliché in oil paper.

5.2.5 Making plastic clichés

Plastic clichés are made as follows:

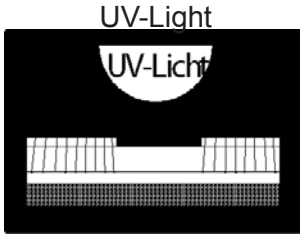
1



Contact with positive film

Remove protective foil carefully. Place positive film on underdeveloped cliché. Use positive films with an optical density of more than 3.5 log. Before exposing, make sure that film and cliché are free of dust.

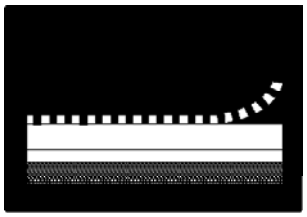
2



Exposure

Expose cliché through positive film. Length of exposure: 1.40 – 2 minutes. (Exposure units are available from us).

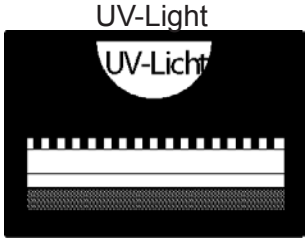
3



Contact with grid film

Remove the positive film and place the grid on the undeveloped cliché. (We carry suitable grid films in our program.)

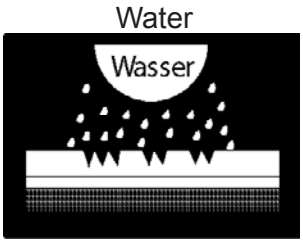
4



Exposure

Expose the cliché through the grid. Length of exposure: same as for positive film. The depth of the etch is determined by the exposure time with grid. The shorter the exposure time, the deeper the print image

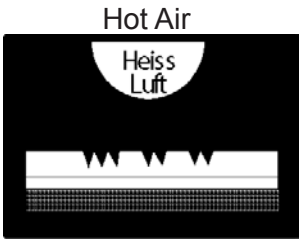
5



Rinsing

Remove the grid. Rinse the exposed cliché with normal tap water. Use water only (no other means). Rinsing length: 60 seconds, water temperature: approx. 30°C..

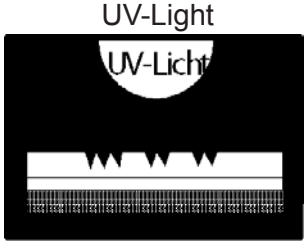
6



Drying

Carefully use compressed air on the cliché, to remove all residues and dust particles from the print image. The cliché is then dried with warm air. Drying time: 5 minutes at 60° – 70°C

7



Post-exposure

To harden the washed areas, expose the cliché for another 5 minutes (without films)

6 Pads

6.1 General informations

In addition to the cliché the pad is an important factor for faultless print. A pad is made of a selected mixture of silicone and silicone oil. The silicone oil is added to the silicone mass depending on the desired degree of hardness. In order to differentiate between the various hardness classes, the pads are coloured with silicone colour.

Only these silicon pads made today make pad print possible. The deep surface tension of the silicone, precisely on the border between ink up-take and ink rejection, depending on the degree of dryness of the ink, allows the excellent colour transfer. A silicone pad should meet the following specifications:

- High mechanical resistance
- Good deflection of static charges
- Stabile surface tension
- Brilliant surface

The silicone oil plays a vital role for the surface tension. After approx. a year, however, it evaporated from the pad, the surface tension increases and the ink transfer is not as good.

A pad only transfers the ink at 100% if is it optimally adjusted. Usually a thin ink film stays back on the pad. By operating the machine at a slower pace or by blowing air on the pad the ink pad can be influenced.

Selecting the pad shape depends on the size and type of the print image and the form of the print object. In this way a flat pad might not transfer enough ink. Ink hole would come to be. A flat pad has also embedded air and therefore places with any ink contact.

The ideal pad form for even surfaces is round.

It is interesting to know that a „roll angle“ of a pad is independent of its form on the print surface is almost always nearly a straight line. The curve form, steep or not so steep, influences only the angle of this straight line.

For smooth printing the roll angle is usually between 20 and 50°

The tip of the pad is of outmost importance. This is a difficult zone, especially for full surface prints without grids. If you cannot move the tip to an ink-free surface, a pad with a medium roll angle and a pointy tip should be used. For a pad which is too flat, the roll angle would be too small. Hole would arise. For a pad which is too point, the print at the tip would be too big. This print would displace the ink in a full surface print. Irregular ink application would be the result.

6.2 Pad selection

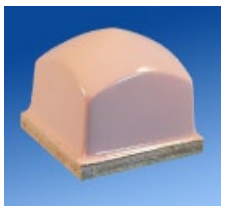
The type and sizes of the print image or the form of the print object often requires a different pad form as the idea round form. Therefore a large range of different pad forms are available.

6.2.1 Pad selection according to pad form

The pad printer will base his selection of pad form on experience or through trials. Luckily more than 90% of all pad prints can be performed with a few different pads. The following compilation shows typical pads and their application. These selections of pads should serve as a rough orientation, they can never replace the own print trials.

Universal round pad with conic print area for many applications

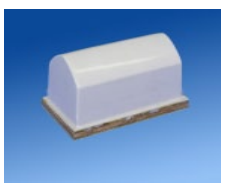
Round pad with round print area. Most suited for printing of round objects



Square pad for square print areas

Rectangular pad for rectangular print images

Saddle pad most suitable for individual words or small print images



Roof top pads for small narrow print images

6.2.2 According to pad hardness

Basically you can print better with a harder pad than with a softer one. A harder pad transfers the ink better, is more constant and vibrates less in fast machines. Therefore you should always print with the hardest possible pad.

Softer pads should be used upon the following criteria:

- Large surfaces
- Uneven over a large area
- Low machine power

By using a softer pad you can print a larger area with the same form than with a harder pad. In addition it is easier to overcome larger uneven surfaces with a softer pad.

However, it must be kept in mind that each pad can only withstand a certain pressure. If the pressure is too large, the pad starts to „flow“ and the print is destroyed. For small uneven surfaces which are typical for example for miniature trains, you need to use a hard pad. By increasing the rubber pressure the impact can be improved.

6.2.3 Rule of Thumb

A rule of thumb for good print quality is:

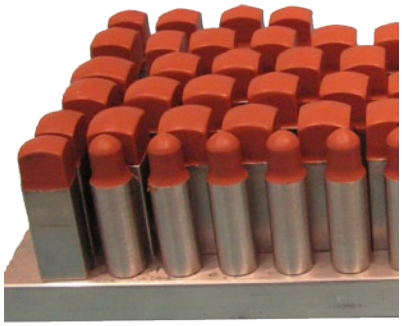
- a higher shore hardness, i.e. a hard pad, a pad form which is a pointy as possibly and the largest possible volume

For perfect results you should observe a couple of rules:

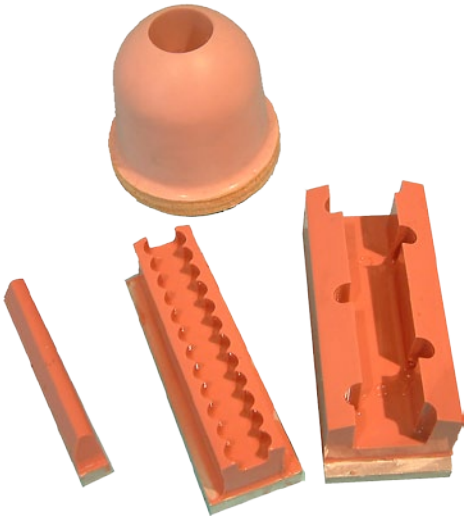
- For fine lines and characters use a steeper pad, for large surfaces use a pad which is less steep
- Compared to the print image, the pad must be large enough – if in doubt choose a larger one
- Whenever possible should the starting point of a pad not be within the ink area
- Adjust the pad in such a way so that it can transfer the print image with the least possible pressure
- Clean the pad only with adhesive film and in the beginning carefully with alcohol
- Store the pad properly so that it cannot be soiled or damaged
- Always use inks which are made specifically for pad printing

6.3 Special designs

Should you not be able to manage with a standard pad, you will need to use a custom-made product. For example through a pad combination in which individual pads are mounted together on a board.



You also can modify an existing pad form (for example by shortening it or by adding hollow spaces and then casting a new pad.



6.4 Pad treatment

6.4.1 Storage

The print surfaces of the pad are very delicate. During transportation you must make sure that these surfaces are not damaged. Some manufacturers use a protective matter, other pack the pad in such a way that no dents or abrasion can form.

Ideally, new pads should be stored without a protective matter at an even temperature (18°C) in a dark room or carton. You must make sure that the pad are not subjected to sunlight or heating.

6.4.2 Cleaning

The pads must be cleaned very carefully. The brilliance of the print surface determines the print quality directly. This surface can be destroyed or the life cycle of a pad can be strongly reduced if the pads are not cleaned properly. A new pad will not transfer any ink if it has not been cleaned. It must be wiped down with a soft, lint-free cleaning cloth and the thinner which was used must be removed.

During breaks or after the end of a printing job the pad should be cleaned in a gentle ink solvent (for example alcohol). Strong ink solvents cause the pad to become brittle and prevent a good ink transfer. A pad may never be wiped down dry or with the palm of your hand. It would destroy its eraser-effect.

All these cleaning problems are eliminated when using a pad printing machine with automatic pad contact cleaning. You can program the pad cleaning process of these machines. A cleaning module with automatic feeder is mounted above the ink feeder system. If the pad needs to be cleaned after use, the ink feeder

Stops over the cliché. Instead of taking on ink, the pad is pressed on the module and starts cleaning itself. This method of cleaning is very safe for the pad. The operator does not have to handle thinner which in return means an environmentally safer work place.

A drastic reduction of scrap is also an additional benefit.

6.4.3 Pad life

The life of a pad can range from few objects to several hundred thousand prints. It very much depends on the state of the print object and the treatment of the pad.

Sharp edges of the print object or dirt particles, improper cleaning and storage can strongly reduce the life of a pad. If the pad treatment measures of this booklet are met, a pad can print between 20,000 to 500,000 prints, depending on the required print quality.

If you work with ceramic inks you can make no more than 20,000 to 25,000 prints. The grain sizes of ceramic inks limits pad life tremendously.

Pad printing machines with automatic pad cleaning are not dependent on the skills of the operator. As a rule pad life is increased manifold.

7 Inks for Pad Printing

7.1 General

All pad printing inks of established manufacturers are suitable for pad printing. However, to select the correct ink for your application you should be aware of the following:

Usually, pad printing inks are modified screen printing inks. In contrast to screen printing inks the pigments in the pad printing inks are rolled much finer and the dosage is much higher to improve opacity.

Pad printing inks consist of:

Printing binders

Colorant

Special additives

Solvents

7.2 Binders

The most important component is the printing binder. It has the task of binding the color pigments with the material to be printed. Together with the special additives, the printing binder is responsible for the mechanical properties of the ink film (adhesion, abrasion resistance, scratch resistance). The printing binder is retained on the material to be printed through various mechanisms.

Ø electric or molecular powers

Ø diffusion of printing binders in the print surface which is swelled up or dissolved through the ink solvent.

Ø mechanical anchoring onto the surface finish of the print good

Ø chemical reaction of the printing binder with the print surface (e.g. for 2-component-inks).

Typically, pad printing inks contain the following printing binders:

Ø Acrylic resin
Ø Cellulose acetate butyrate
Ø Collodium
Ø Epoxy resin
Ø Colophony resin
Ø Condensation resin
Ø Melamine resin
Ø Polyester
Ø Polyurethane resin
Ø PVC- mix polymerization

These printing binders are frequently combined with one another to provide for the many requirements.

The table on page 52 shows this combination together with the specific print good.

7.3 Colorant

For colorants you have to differentiate between inks and pigments. Inks are soluble and split into individual molecules. There is no light dispersion from particles this small. Therefore, the inks are transparent. Inks are suitable for multiple color halftone printing, where the individual colors are generated with the respective base color on a light substrate.

Pigments are not soluble. They can be made up of organic or in-organic base materials. Through pigments you can achieve opaque prints.

7.4 Special additives

Additional raw materials, so-called additives are added, to optimize the ink film characteristics:

- Ø softeners to improve flexibility and adhesion
- Ø waxes to improve the mechanical properties (scratch and abrasion resistance)
- Ø various additives to improve processing, to increase gloss or to generate matt ink films.

7.5 Solvents

Solvents are needed to manufacture pad printing inks out of the above described components (printing binders, pigments, auxiliary materials). Solvents are volatile, low viscosity, liquid, chemical compounds which transform the printing binders into a liquid form. The proportion of solvent in the inks amounts to approximately 70 percent.

To use solvents in inks a number of physical properties are important:

- Ø Evaporation
- Ø Flash point
- Ø Inflammation temperature
- Ø MAK value

7.6 Drying

There are three different ways to dry pad printing inks:

- Ø physical drying
- Ø chemical drying
- Ø oxidative drying

7.6.1 Physical drying

During physical drying the printing binder is dissolved only for processing. While the solvents evaporate, the ink film develops. The material is not changed. If the ink film is sprinkled with solvents again, the printing binder turns liquid once again.

7.6.2 Chemical drying

During chemical drying the printing binder is not sufficiently high-molecular. This reaction is triggered by a hardener which was added to the ink prior to the print. The change-over to this high-molecular final state occurs only after physical drying on the material which is to be printed. The printing binder is modified. Returning to the initial state is not easy.

7.6.3 Oxidative drying

During oxidative drying the inks link when aerial oxygen is added. A main oxidation process takes place which leads to the linking of color components

7.6.4 Summary

The first phase of a drying process is a purely physical event during which the solvent evaporates. In a second phase a chemical reaction takes place in 2-component-inks, where smaller binding molecules interlink to form new, larger chains or networks.

The complete hardening of the colors can take up to 6 days. With an appropriate heat treatment, the drying process can be accelerated and the adhesion and ink layer quality is improved.

7.7 Single-component-ink

A single-component-ink is completely sufficient for many applications. These are applications where no strong chemical consistency is needed, possibly with the exception of alcoholic cleansers and where the color can loosen the base material. For single-component-inks the film is formed alone through the evaporation of the volatile, organic solvent. The binder remains chemically unchanged. When subjected to a suitable solvent the film can be dissolved at any time.

Therefore, you can always print over single-component-inks.

7.8 2-component-ink

As the name implies, 2-component-inks are made of two components; color and hardener. Color and hardener are mixed prior to processing, as per the instructions. From this time on the linking reaction begins. During processing the mixture becomes increasingly thicker due to the continuous chemical reaction until it gels and can no longer be used to print. Even the addition of solvents cannot change this. In the documents this processing time is referred to as „pot life“,

which is typically 8 hours. It should be mentioned that the adjustment of the proper degree of thinning plays an instrumental influence on the processing time. Inks which are not thinned enough gel faster than inks which are properly thinned.

2-component-inks can only be printed over within approx. 15 hours. After this time there is not enough polymerization between both color films.

2-component-inks are usually used, if the color film is subjected to scratches, must be resistant against aggressive mediums or adhere to so-called „difficult substrates“ (for example polyolefins). However, first-class results can only be achieved if the material which is to be printed is sufficiently durable against the medium.

You frequently use hydroxyl group similar polymers on a polyester or polyacrylate base as a bonding agent for 2-component-inks. These are chemically linked (polymerized) by adding a hardener based on a polymer epoxy.

The base products resin and hardener are soluble in the appropriate solvent. The polymerized products are practically non-soluble which leads to improved resistance.

Another 2-component-system is based on suitable polyamide resins which are linked by a polymer epoxy.

7.9 Special inks

7.9.1 UV inks

UV inks consist of monomers and photo-initiators. They do not contain solvents. They only harden when subjected to ultraviolet light. This has the big advantage that the ink cannot dry out in the machine. While UV inks can easily be used in screen printing, they are difficult to process in pad printing. The UV inks have the negative characteristic to accumulate on the pad. Lately, however, there are inks available which do not have this tendency. Unfortunately, these are only available in the colors black and white.

7.9.2 Fluorescent colors

Fluorescent colors or signal colors reflect daylight and UV light. Small little beads cause a reflection by carrying the color pigments on their circumference. In order to properly transfer fluorescent inks by pad print, these little beads must be reduced in size. Unfortunately, the line of breakage does not have color pigments, the color layer would be so thin that the reflection would be too weak.

At the same time, the light resistance would be strongly diminished, so that the colors would fade within days.

Nevertheless, fluorescent inks can be transferred, if you accept the following compromises:

1. In order to form an ink layer, a quadruple or quintuple print is necessary.
2. Due to the relatively large grain size, fine lines cannot be printed
3. Fluorescent inks must be printed on a white substrate.

7.9.3 Phosphorescent inks

Phosphorescent inks, also called noctilucent colors, use crystals as „light storage“. These crystals start to vibrate when subjected to light. The vibrations continue after the light source has been removed and dispense the stored energy as light. If the crystals would be reduced to a size, suitable for pad printing, these would be so small that they could not store any energy. In addition, a decrease in size of the color pigments would significantly reduce the light resistance.

7.9.4 Thermal setting inks

Thermal setting inks were developed to print on acetal-polymers (Hostaform C, Delrin).

The color is transferred by normal pad printing and then diffused in through heat. After the heat treatment and cooling off period the excessive color has to be rinsed off with water. The scratch resistance corresponds with the surface of the printed material.

Only dark prints on light substrates are possible. The color of the substrate influences the final color of the print. Usually, the following color shades are available: black, violet, yellow, blue, brown, red, orange, and green. White is not possible.

7.9.5 Sublimation inks

Sublimination inks were developed to print on polyester. The color can be transferred with normal pad printing and diffused into the material with heat. The scratch resistance corresponds with the surface of the printed material. The color of the substrate influences the final color of the print. Color shades can be mixed out of the three base colors. White is not available.

7.9.6 Inks based on water

Inks based on water are in the process of being developed (as of 1988)

7.9.7 Food inks

Food colors cannot be transferred with pad printing.

7.10 Ink selection/ print material

7.10.1 General

In this chapter we describe the selection of suitable ink types for certain print materials. In the field further criteria when selecting inks need to be considered, such as: area of application, non-toxicity, resistance against environmental influences, price, etc.

Basically, you can find suitable inks on the market for almost all base materials. In regard to prices it must be kept in mind that the ink costs are usually a very insignificant proportion of the final product costs. Therefore price plays a minor role, especially since complaint costs can increase quickly.

It is very important that prior to serial printing each pad printer makes it a habit to test for color adherence and resistance on the print material.

This is necessary as the print materials are often soiled or have deposits acquired during manufacture.

For plastics you must distinguish between two descriptions: trade name and chemical name. The approximate 3,700 trade names can be subdivided into three plastic groups. Typical trade names include: Nylon, Lexan, Ertalon, etc. Typical chemical names are: polyvinylchloride, polystyrene, polyamide, etc.

In the chapter „Data“ the most common trade names and chemical names are listed.

Very often, you need to print on plastics of which you do not know the name. To recognize plastics, there is a relatively simple test which is described in chapter 9.0

7.10.2 Acry1ic glass

Acrylic glass is translucent, very weather resistant, deformable through heat and resistant against acids, bases, water, fats, and oils. Due to its characteristics, acrylic glass can be used for the manufacture of illuminated advertising, machine faceplates, housings, etc. Articles made of acrylic glass which are made by extruding or injection-molding and which were cooled down too quickly, tend to stress crack during printing. In this case tempering or suitable temperature control when cooling the molds will help.

For printing you can use a single-component-color based on alkyd resin or a 2-component-ink.

7.10.3 Bakelite, melamine resin

Bakelite and melamine resin are difficult print materials. These plastics must be printed with 2-component-inks. A flame pre- or post-treatment results often in the significant improvement of color adhesion.

7.10.4 Metal, glass, porcelain, chrome steel

Usually, these materials require a thermal post-treatment. There are special inks for glass, which are burnt in 30 minutes at 120°C. (Not to be confused with ceramic inks, which require heats of 550°Celsius.)

7.10.5 Polyacetate

Polyacetate, known under the trade name DeIrin or Hostaform C, is used for gliding functions, slides, valve units, and also pocket lighters. It is very resistant to the usual solvents.

Usually, a 2-component-ink based on epoxy resin is used for printing. Adhesion of the ink is only achieved through thermal post-treatment. This can either be achieved through hot air or a flame treatment.

7.10.6 Polycarbonate

Polycarbonate are specifically used for transparent housings, plug parts, clamps, lamp glass, insulation parts, small apparatus housing, household parts, etc. Polycarbonate is strongly affected by the ink. Given extruded material this can lead to visible stress cracks, which can negatively influence the impact strength.

Polycarbonates are primarily printed with a single-component-ink. However, 2-component-inks (based on epoxy resins) can also be used.

7.10.7 Polyester

Polyester is a hard, abrasion-resistant, stable plastic which is resistant to organic solvents.

It is heat resistant up to 180° Celsius and can therefore be printed with a baking ink. Polyester is usually printed with a 2-component-ink based on epoxy resin. If very high abrasion-resistance is required, for example on the caps of pushbuttons, a sublimation ink is used which is in-sublimated through heat after the print.

7.10.8 Polyethylene, polypropylene

Polyethylene and polypropylene are especially resistant against acids, bases, water, organic solvents, and chemicals. Inks do not adhere to a surface which was not pre-treated, as the surface tension is too deep. Therefore, a preliminary corona or flame pre-treatment is necessary. Usually a 2-component-ink based on epoxy resin is used on these types of materials.

7.10.9 Polystyrene

Polystyrene is resistant against acids, bases, water, oils and greases, but not against organic solvents. Polystyrene is strongly affected by the ink and tends to hairline cracks. A single- component-ink is sufficient for polystyrenes. Due to the reaction to the ink, it blends with the base material which leads to very good adhesion.

7.11 Ink preparation and transfer

Purchased pad printing inks are usually ready to be printed. Normally, the viscosity must be adapted to the required processing viscosity. For 2-component-inks you need to add a hardener

prior to processing. It is imperative that the mixture between ink and hardener is carefully weighed and then mixed. Never add hardener by estimating the quantity.

When processing pad printing inks, make sure that they are homogenous and well pre-mixed before adding them to the color tub. Thinning the ink in the tub should be done only very slowly. By adding a relatively large amount of thinner, a pigment shock may occur which may lead to flaking of the pigments. Finding the proper degree of thinning, i.e. the consistency, with the individual pad printing thinner or possibly a retardant is also a point for which you need sure instinct and experience. If the ink is too thin, surface problems may arise, when the drying process is to be accelerated with the help of a hot air blower. At the same time the opacity is reduced and color shades made be modified. If the viscosity of the ink is too high, it might become „stringy“.

Using retardants is not easy. Whenever possible these should be avoided.

If the color releases the solvents too quickly, it might dry in the cliché and stick to it or after transfer may not adhere too well on the print material. If retardants are used, the color surface on the pad is not sticky enough and the pad printing ink is not transferred to the print material. This means that adhesion of the wet ink on the silicone rubber of the pad is larger than the adhesion on the print material. This can be corrected by blowing air on the ink film which is on the pad, whereas a portion of the solvent on the print color evaporates resulting in stickiness needed for transfer.

The composition of the pad printing ink and its drying characteristics in the recess of the cliché or on the pad is very instrumental to printing speed. Based on these facts it is obvious that the correct color modulation cannot always be achieved by the ink producer, but must be specifically adapted to the local conditions of the individual machine.

7.12 Quality controls

7.12.1 Miscellaneous

The quality controls of colors need to be divided into two inspection phases. The first inspection phase is performed by the manufacturer, the second one by the user. The manufacturer inspects the following:

- viscosity
- color shade
- degree of glossiness
- pigment grain size drying time
- filler resistance, etc.

The user will perform the following inspections depending on requirements and experience:

- viscosity
- surface hardness, fingernail (scratch) test, scotch tape test
- cross hatch
- special abrasion tests (for example Taber abraser)

7.12.2 Viscosity

Precise viscosity measurements are obtained with the help of a rotation-viscosity-meter. This unit determines the energy (inner friction), which is needed to counter the rotation of a liquid substance, in our case a pad printing ink. You must note the temperature dependency of the viscosity when measuring. A temperature increase of 1° causes the viscosity to decrease 10%.

Therefore, you should always measure viscosity at 20° C.

The operator of the machine will not have these precise viscosity gauges available. Moreover, he doesn't need them because a simple scraper will suffice to adjust the color. If you move the scraper quickly through the ink, the „trench" which is formed behind the scraper must disappear immediately. The ink must be thinned according to experience.

Of course, it is much simpler, if a Viscomat assumes further control on the ink's viscosity.

Proper adjustment of the viscosity is of utmost importance for processing and print quality.

There are some pad printing ink manufacturers who prepare their inks so that they are ready to print. However, prior to use most of these inks need to be thinned.

7.12.3 Pigment grain size

The pigment grain size is normally measured with a so-called grindometer. Other gauges are the Grindopac and the grain size gauge by Garmsen. The grindometer is a measuring gauge where grain size is determined simply by scraping the color and reading the grain size in um (see „What exactly is pigment grain size?")

7.12.4 Degree of glossiness

By using ink additives the degree of glossiness can be adjusted from matt to high gloss. The degree of glossiness is measured with the gloss meter according to length.

7.12.5 Surface hardness

The surface hardness of an ink is essential for its abrasion resistance. With a hardness test pencil by Erichsen you can measure the surface hardness of pad printing inks (see „What exactly is surface hardness of inks?“)

7.12.6 Fingernail test

With the fingernail test you try to push away the color film with your fingernail. This is a very frequently employed test which should not be underestimated. If the color film endures this test the adhesion is quite good.

7.12.7 Scotch tape test

By applying a piece of scotch tape you try to remove the ink film. This is also a very effective test which provides a lot of information on the ink’s adhesion.

7.12.8 Cross hatch cutter test

For the cross hatch test you need a cutter with an 8-fold cutting head. With the help of this cutting head you make 2 cuts in a right angle on the specimen. This results in 49 small squares. These squares are then inspected under a magnifying glass and a cross hatch value is assigned „see under „What exactly is a cross hatch?“)

7.13 Multicolor print

In pad printing you can transfer the colors „wet in wet“. This means that, unlike for screen printing, intermediate drying is not needed. This is due to the quickly drying, thin color film of the pad print and the silicone pad, which barely takes on any color, once it has dispensed it.

You must distinguish between the bold, plane with normal pad printing inks printed multicolor print and the real multicolor print with an offset grid and inks with dyes.

Multicolor inks with normal pad printing inks are opaque inks which means that by printing over you will not receive new color shades. The substrate color has little influence on the print. Usually, you start out by transferring the lighter shades.

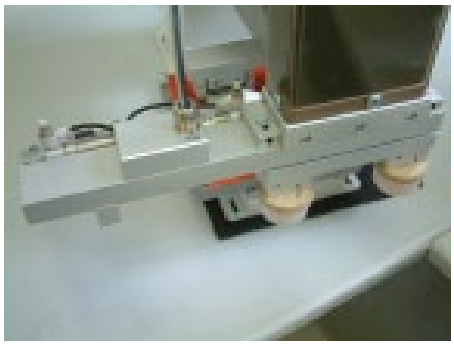
With the offset grid cliché the colors are transferred on the base of dyes. These colors are translucent. Hence, all color shades can be achieved depending on the colors of the offset films.

As these colors are translucent they must be used on a light substrate or the areas which is to be printed needs to be highlighted with white.

When etching the offset cliché you must know that the etching depth is not the same as with normal clichés. For delicate shadings it ranges from approx. 10 um to 20 um for good opacity.

Nowadays, three machine systems have prevailed for multicolor prints.

7.14 DIN safety data sheet



Simple two-color printing machine

Multi-color printing machine shuttle unit

Multi-color printing machine MS 250 with pad shifter

Multi-color printing machine MS 500 with pad shifter

Intelligent Pad printing System 1 to 5 color Programable Rotary Indexer

Requires only one print part fixture

Pad printer with Oval Track for 4 or 5 color print
For high volume printing, requires 12 or 14 print part fixture

The safety data sheets describe the composition of inks and their solvents. This information is needed to met the necessary measures for the safety during transportation, storage and processing of these chemicals. The composition of these safety data sheets can vary from country to country. In this booklet we concentrate on DIN safety data DIN 52900.

This safety data sheet is set-up as follows:

The header of this sheet must include the name of the manufacturer and the trade name of the product.

This is followed by the actual data which is divided into nine paragraphs:

1. product description
2. physical and safety regulations
3. transportation
4. instructions
5. protective measures, storage and handling
6. measures in case of accidents and fires
7. toxicological details
8. ecological details
9. further information

All of thee main paragraphs are subdivided into subparagraphs. In the following chapters these subparagraphs are described, focusing on the needs of the pad printer. This description can never replace the actual data sheet. It should only show what information is provided by these safety data sheets.

7.14.1 Safety regulations

All pad printing inks have one thing in common: about 70% of the ready-to-print mixture is dispensed into the air. This ecological burden cannot be simple ignored. Over the last couple of years the regulations have been tightened in various countries. The manufacturers are trying their best to produce inks which are as little toxic as possible. Nevertheless, inks contain toxins and therefore it is of utmost importance that the safety regulations are met.

The safety regulations for inks can be divided into three parts:

1. safety regulations for manufacture and transportation
2. safety regulations for processing
3. safety regulations for the color on the print material.

7.14.2 Safety regulations for manufacture and transportation

It would go beyond the scope of this book to include all regulations for the manufacture and transportation of inks; in particular, as there are significant differences between the developed countries. These regulations are especially important for the manufacturer of inks.

7.14.3 Safety regulations for processing

The safety regulations for processing colors are illustrated through symbols and with texts on the color label of the ink containers.

A color label includes the following details:

- Poison categories
- Danger warnings
- Safety advice

Poison categories

Pad printing inks and the appropriate solvents are usually part of poison categories 3 and 4. The poison categories are symbolized on the color label. In the European Market poison category 3 is a black cross on a yellow background; in Switzerland it is a yellow cross. In addition to this yellow cross the type of poison must be listed (for example: contains buty glycol – hazardous to your health)

Poison category 4 is not specifically labeled within the European Common Market, in Switzerland it is signified by a red dot.

Danger warnings

Danger warnings, also called R phrases, indicate danger. The following R phrases are typically used for pad printing inks:

R 10 flammable

R 20/21/22 harmful by inhalation, if swallowed and in contact with skin

R 36/37/38 irritating to eyes, respiratory system and skin

R 43 may cause sensitization by skin contact.

Safety advice

Safety advice, also called S phrases, recommend approaches when working with inks, to increase personal safety. The following S phrases are usually used for inks and solvents:

S 20/21 when using do not eat, drink or smoke

S 24/25 avoid contact with eyes and skin

7.14.4 Safety regulations for the color on the print material

For printing on basic commodities, which are subject to the food and commodities legislation and for toys and writing instruments, for which the standard draft DIN pr EN 71 „Safety of Toys, Part 3“ applies, there are specially designed inks. These inks may not exceed the following values of soluble elements:

100 mg/Kg lead

250 mg/Kg antimony 100 mg/Kg arsenic

500 mg/Kg barium

100 mg/Kg cadmium 250 mg/Kg chrome

100 mg/Kg mercury

These inks are often called „Non Toxic“ or „NT“. Many inks are of NT quality. However, if you need NT quality make sure to specify this on your order and have the vendor confirm accordingly.

7.14.5 Summary

As mentioned in the beginning, the ink container lists only the most important information for the pad printer. For each color and solvent a safety data sheet needs to be maintained according to DIN which lists the ink in detail. These data sheets can be obtained from your ink vendor. A sample of such a data sheet is described in the next chapter.

Although pad printing uses relatively little ink, the safety regulations should be met for your own safety. Good ventilation is very important. To avoid skin contact with inks you can buy lotions which are rubbed on your hands before working with inks and can be washed off after work. These lotions keep your hands clean and smooth.

7.15 Subdivision DIN safety data sheet

7.15.1 Product description

7.15.2 Chemical characterization

Examples:

Colored, thick ink

Binders: acrylic resins and PVC polymers

Pigments: organic resp. inorganic pigments

Solvents: ester, ketones, Glycol ether, etc.

7.15.3 Form

Examples:

liquid, paste-like

7.15.4 Color

This is the normal specification; depending on coloring.

7.15.5 Odor

Examples:

Organic solvents

7.15.6 Physical and safety regulating data

7.15.7 Change in state

Change of state refers to a modification of form, from solid, paste-like, liquid or gaseous at various temperatures. This does not apply to pad printing inks.

7.15.8 Density, bulk density

Density is defined as the weight of one liter of ink.

7.15.9 Vapor pressure

Vapor pressure is measured in bar at a specified temperature and sea level.

7.15.10 Viscosity

The viscosity is listed under this heading as in point 1.2 Form: paste-like or liquid. The section „What exactly is…“ describes what viscosity means. The processing viscosity is described in the chapter „Print technology“.

7.15.11 Water solubility

The solubility in water is divided into soluble, mixable and non-soluble.

Pad printing inks and its solvents are usually non-soluble or mixable.

7.15.12 Flashpoint

The flashpoints for pad printing inks arise from the danger categories and must be listed on each ink container.

7.15.13 Inflammation temperature

The inflammation temperature of pad printing inks ranges between 200 and 300 ° Celsius.

For regulations on occupational safety please refer to the safety regulations of the Trade Association, as well as the Regulations for Dangerous Materials.

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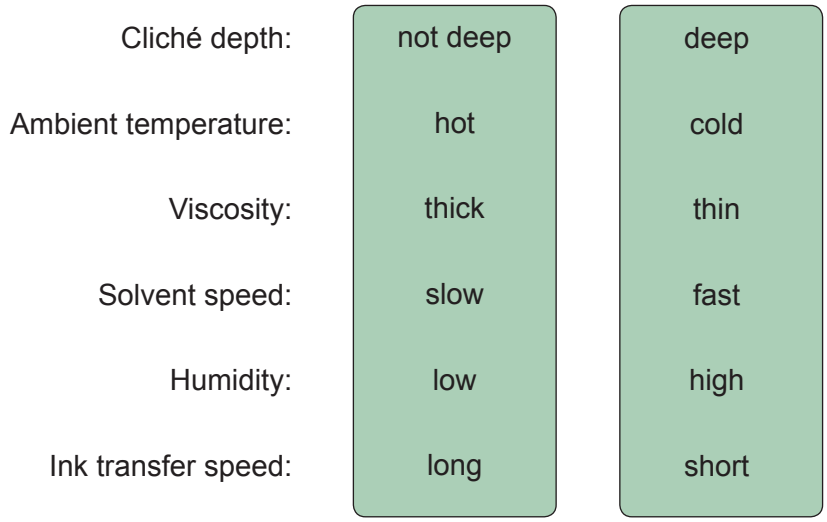
8 Pad Printing Technology

8.1 The pad printing „window“

Every process has a „window“ during which the process can take place. This applies as well to pad printing.

For example:

- Ink can only be transferred sharp-contoured and opaque given a certain cliché depth
- You can only print properly given a certain range of temperature
- Ink can only be transferred given a certain range of viscosity
- Ink can only be transferred given a certain evaporation speed
- You can only print properly given a certain range of humidity
- Ink can only be transferred given a certain ink transfer time range.



Each of these parameter characteristics can be influenced by changing another parameter.

Example 1:

If the ambient temperature is too high you can counter not only by reducing the temperature, but also by:

- making the cliché somewhat deeper
- thinning the ink a little
- reducing the evaporation speed of the solvent
- increasing humidity
- shortening the ink transfer period

Example 2:

If the cliché is not deep enough you can counter this by not only deepening the cliché but also by:

- reducing the ambient environment
- thinning the color somewhat
- slowing down the evaporation speed of the solvent
- increasing the humidity
- reducing the ink transfer period

These examples are meant to show the mutual dependencies. Of course it is always best to get to the bottom of the problem and to modify the parameter which is causing the problem.

However, given smaller interferences you often choose the parameter which can be changed easiest.

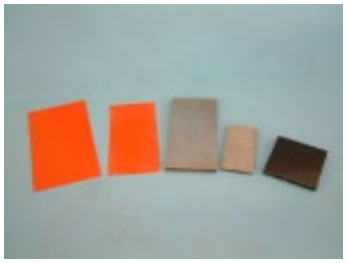
8.2 Pad print „Hardware“

8.2.1 The Pad

To achieve perfect results you should follow these rules:

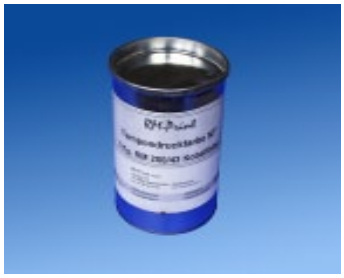
- Choose a steep pad for fine lines and figures; for larger prints select a pad which is not as steep.
- The pad must be large enough when compared to the print image – if in doubt, use a larger one.
- If possible, the touchdown point of the pad should not be within the ink area.
- The pad should be adjusted in such a way that it transfers the print image with as little pressure as possible.
- Only clean the pad with adhesive film and in the beginning slightly with alcohol.
- Store the pad so that it cannot be soiled or damaged
- Always use inks which are made specifically for pad printing
- The life of a pad is limited. The pad cannot print better than the original print image to be transferred. If the print image is not very sharp on the pad, if the surface is rough, if the pad is leached, i.e. the inks bleed or if the surface was damaged by sharp edges, the pad must be replaced.

8.2.2 Cliché



- Use steel clichés for large volumes.
- Etching depth for fine figure 0.018 - 0.020 mm, otherwise choose a depth of 0.024 mm.
- You need a grid for plastic clichés, i.e. the points must reach to the surface.
- After rinsing, submerge once again in a suitable washout medium and rinse thoroughly, expose and dry it well.
- The life of a cliché is limited. Clichés are worn down by the doctor blade. As a result, the print imagine is no longer as saturated or the ink cup starts to leak.
- Plastic clichés can also be scratched through dust from the outside.

8.2.3 Ink



- Use only good quality pad printing inks.
- Mix the ink thoroughly and pre-dilute (if you move the mixing stick through the pot and the ink closes right behind the stick, the viscosity is acceptable).

8.3 Trouble shooting

For pad printing it is essential that the surface of the print materials is clean and free of oil, separating agents or other contaminations. In addition, you should ensure that there is a normal ambient environment of approx. 20° Celsius during printing and that all printing components (inks, solvent, pad, clichés, print material) are brought to this temperature.

If for example, the ink or the print material was stored in a cold room and then used immediately for print you cannot expect a proper, regular print result. As you know, the viscosity of print inks is dependent on the ambient temperature. Often the cold ink is diluted so that it becomes too thin once it has adapted to the ambient temperature.

8.4 Electrostatic charge

Electrostatic charges mean imbalances in the electric charge of materials which are in close proximity. This occurs primarily through charge separation of fast-running machines or through charge displacement, which is caused by persons moving through charged areas.

In general, plastics are very poor electric conductors and the surface resistance is usually somewhat lower compared to the resistance inside of the material due to absorption of humidity. A rule of thumb maintains that material with a surface resistance less than 1011 Ohm, according to DIN 53482, cannot be charged electro-statically. The material cannot be charged if its surface resistance, given a normal temperature of 23°C, 50% relative humidity, is less than 109 Ohm or, given extreme conditions, does not exceed 1011 Ohm. (Guideline no. 4 of the Trade Association for Chemistry).

Many plastics, however, have a higher surface resistance. Through contact or wear, often through the manufacturing process, static charges can occur, which can interfere with the printing process upon unfavorable weather or humidity. The pad, also, can be electro-statically charged through pressing and subsequent relaxation of the surface, given unfavorable humidity. This can lead to splattering and that the pads attract dirt.

Static charges can be measured with a field force gauge. With the help of this static measuring device which works according to the influence method, you can measure electro-static charges, fields or potentials contact-free, even in areas which are difficult to access.

There are two methods to eliminate problems caused by static charges:

1. Static inhibitors for plastic and inks
2. Ionization units

In both cases, however, you must ensure, that the relative humidity does not fall below 60%.

8.4.1 Static inhibitor

Static inhibitors can be added to the base material and the ink. Unfortunately, this leads to a decrease of quality. For 2-component-inks you may not use any static inhibitors, as this would modify the ink quality significantly. As an emergency measure against static charging you might try to rub the pad with a suitable static inhibitor.

Static inhibitors may only be used with great care and only after they have been tested in detail.

8.4.2 Ionization unit

An ionization unit consists of an ionization electrode and, depending on the application, an air blast unit. The ionized air blast, which leaves the unit, conducts electricity and can therefore discharge static charges. For pads you can use an ionization rod which you position between ink intake and ink release. The rod should be 20 mm longer than the largest pad. In addition, the air supply should be cleaned through a very fine filter. To discharge the print material you may use an ion-generator with compressed air. At the same time, the strong blast of air removes any possible dust. Make sure that the blast of air is not aimed towards the cliché, so that the color does not dry too quickly.

8.5 Pre-treatment

There are some non-polar plastics which have a surface tension of less than 38 dyn/cm. Inks cannot adhere to such surfaces. In the field, a surface tension of 38 to 40 dyn/cm has shown to provide adequate print adhesion, by over 44 dyn/cm, no improvement was evident.

Natural surface tension of common materials (dyn/cm):

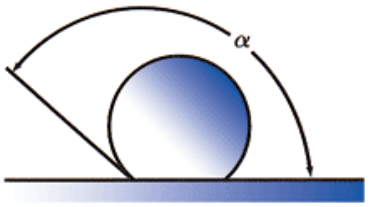
Polytetrafluorethylene (Teflon)	19-20
Silicone	24
Polypropylene	29-31
Polyethylene	30-31
Polymethyl-Methacrylate	36
Polyamide	26-46
Polystyrene, ABS	38
Polyester	41-44
Water	72

The surface tension can be measured with two different methods.

1. sessile drop method
2. pendant drop method

8.5.1 Sessile drop method

To measure the contact angle, a drop of water is placed on the pre-treated polyethylene. Using a light source, a parallel adjusted light hits the water drop horizontally. With the help of lenses the focal point of 1.5 cm is enlarged 30 times and projected unto a focusing screen. A protractor is attached to the focusing screen and you move the contact point of water drop to foil to coincide with the zero-point. With the help of a moveable needle you can use the zero-point of the protractor to position the tangent on the projected image of the drop and read the contact angle.

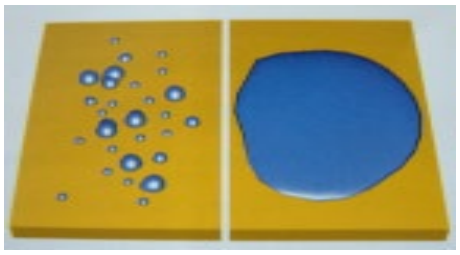


8.5.2 Pendant drop method

The most frequently applied surface tension test is performed with the help of an inspection ink. You can buy felt-tip pens which are filled with testing inks for a measuring range of 32 dyn/cm to 50 dyn/cm, graduated in 2 dyn/cm.

To measure surface tension you apply a liquid film with these felt-tip pens on the area to be tested. The film may not contract to form drop shapes within 2 seconds. If the film contracts after 2 seconds, a mixture with the next higher surface tension is applied. If the film resists less than 2 seconds, a new test with a mixture of the next lower surface tension is performed.

The surface tension of the mixture corresponds with the tension of the test sample if the film holds together for exactly 2 seconds.



Beads up does not bead up

kits for testing surface tensions

8.6 Pre-treatment

The idea of pre-treatment is to increase the surface tension to at least 38 dyn/cm so that the ink adheres. Pre-treatment modifies the surface physically and chemically. The treated areas will be less glossy, depending on the type of treatment.

Polyethylene, in particular low density polyethylene, contains fillers or other additives. Lubricants and static inhibitors can negatively influence the effects of the pre-treatment.

For example, lubricants and static inhibitors migrate to the surface and form a thin film. We therefore recommend pre-treating as soon as possible after the parts have been manufactured. For low pressure polyethylene a pre-treatment after 8 days is barely effective. Ink adhesion may no longer be given. Pre-treatment is most effective right after pressing, when still warm. This requires less energy and the result is optimal.

The pre-treated goods can then printed at any time; there is practically no time limit.

There are four types of pre-treatment:

1. chemical pre-treatment
2. flame pre-treatment
3. corona pre-treatment
4. plasma pre-treatment

8.6.1 Chemical pre-treatment

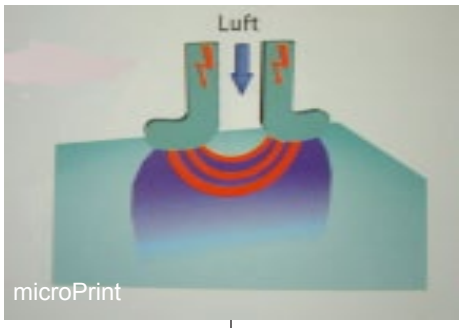
The chemical pre-treatment takes place with a primer. The primer is applied with a cloth on the location which is to be treated. A chemical process causes the surface tension to be increased. This method is only economical for small series. A very good ventilation is a must.

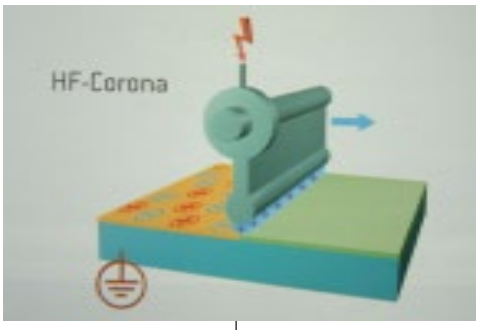
8.6.2 Flame pre-treatment

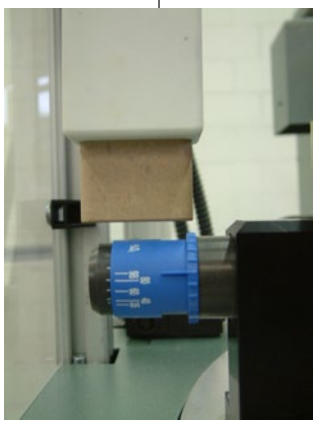
Next to plasma pre-treatment, treating plastic articles with the help of a gas flame is still one of the most effective, rational and universal methods to modify the surface of articles made of PE or PP so that you can print on it. The gas flame bridges a large range of tolerances and can therefore pre-treat even irregularly shaped articles. The investment costs are low in contrast to plasma treatment. Gas consumption is minimal. Indexed machines use approximately 0.15 Euro/hour.

8.6.3 Corona pre-treatment

A corona pre-treatment unit consists of a high-frequency AC generator and two discharging electrodes. These electrodes discharge electrons and ions. There are two different systems. One system uses the article to be treated with the retainer acting as a counter electrode. In the other system, both electrodes are above the article to be treated and with a blast of air the discharge is blown onto the print surface. The surface is hereby modified physically and chemically. These primarily non-polar molecules turn polar through oxidation. This process causes the surface tension to be increased and therefore the printing ink can adhere more easily. The electrode must be adjusted to suit the print item.

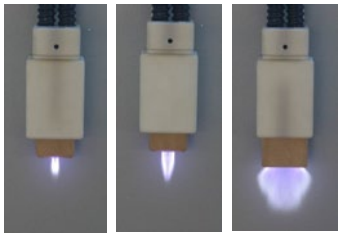






The power range of an electrode cannot be increased arbitrarily. Therefore, several electrodes are operated parallel given higher speeds; two from approx. 100 mm/min. and faster.

Corona treatments cause ozone. Larger plants must have exhaust systems. As a rule of thumb: as soon as you can smell ozone, the concentration is already too high.



8.6.4 Plasma pre-treatment

Plasma treatment is the most effective pre-treatment in pad printing due to a combination of chemical and physical impacts. The treatment depth is over 10nm, while for other pre-treatment types the depth ranges between 5 to 10nm. The plasma generator produces a potential-free plasma jet. The article to be printed is not subjected to high voltage; hence the treatment is potential-free.

In contrast to all other treatment options, plasma units are very expensive. Therefore, plasma is usually only used for surfaces which are very difficult to print or if absolute process reliability is required.

plasma generator

plasma producer

plasma jet

microPrint LC GmbH
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8.7 Pad does not take on ink film

Problem Area	Possible Cause	Trouble shooting
Ink microPrint	Viscosity is too low Dried in Wrong thinner	Dilute ink Clean the plate with thinner Use a slower thinner resp. one that corresponds to the ink
Printing Plate microPrint	Etching depth is too low..... Wrong type of screen Surface (of plastic plates) is.... mechanically damaged	Try a new plate with more etching depth Try a new plate with a different screen Try a new plate
Pad microPrint	Pad too flat Rough surface Surface too repellent.....	Use a more pointed shape pad Use of a new pad clean several times
Others microPrint		

8.8 Pad releases the ink film improperly

Problem Area	Possible Cause	Trouble shooting
Ink microPrint	Dried on the pad..... Too wet on the pad ..... unable to stick	Use a slower thinner Use a faster thinner
Printing Plate microPrint	Wrong type of screen..... Etching depth is too low.....	Try a new plate with a different screen Try a new plate with more etching depth
Pad microPrint	Wrong shape..... Rough surface	Use a more pointed pad Use a new pad
Material microPrint	Dirty surface (grease, oil, separating agents, hand sweat)	Pre-cleaning with alcohol; if necessary wearing gloves when inserting
Others microPrint	Printing sequence is too slow. Room temperature is too high	Keeping regular cycle times The room temperature is best at 18 - 20 °C if not use temperature control device short movie: www.microprint.ch/xx

8.9 No proper flow of the ink film

Problem Area	Possible Cause	Trouble shooting
Ink microPrint	Viscosity is too low..... Viscosity is too high..... Insufficient mixing of ink and additives	Reduce amount of thinner Dilute The ink has to be mixed thoroughly before being poured into the ink cup
Printing plate microPrint	Wrong etching depth..... Wrong type of screen.....	Check depth, if necessary try a new plate Test a new plate with a different screen
Pad microPrint	Rough surface..... Wrong shape.....	Use a new pad Use a different shape
Material microPrint	Dirty surface	Pre-clean with alcohol
Others microPrint	x	x

8.10 Solid areas are not completely printed

Problem Area	Possible Cause	Trouble shooting
Ink microPrint	Viscosity is too high..... Wrong type of ink..... Transparent color shade.....	Reduce amount of thinner Use pad printing inks Use opaque shades
Clichée microPrint	Etching depth too low..... No inclination of the printing image Wrong type of screen.....	Try new plate with more etching depth Inclination of 5°-15° Test new plate with a different screen
Pad microPrint	Wrong shape..... Too soft..... Rough surface.....	Use harder pointed shape Use harder pad Use new pad
Material microPrint	Structure of the surface is too rough Dirty surface.....	Use harder and more pointed pad shape Pre-cleaning e.g. with alcohol
Others microPrint	Digging of the doctor blade Only single print	Use thicker doctor blade or a screen or of inclinations Double prints or bottom printings with an opaque shade(white)

8.11 Insufficient opacity

Problem Area	Possible Cause	Trouble shooting
Ink microPrint	Viscosity is too low..... Transparent color shade..... Wrong type of ink..... Low ink transfer.....	Reduce amount of thinner Use opaque shades Use pad printing inks Defect may be caused by pad or die plate
Cliché microPrint	Etching depth is too low..... Solid areas without screen..... Solid areas without inclination Wrong type of die plate..... Wrong type of screen.....	Try new plate with bigger etching depth Use a screen Inclination of 5° - 15° Use type that is suitable for screen Test new plate with a different screen
Pad microPrint	Too flat..... Rough..... Too soft	Use more pointed shape Use another pad Use harder pad
Material microPrint	Dirty surface ..... Dark substrate ..... Structure of the surface is too rough	Pre-clean with alcohol Double print Use harder and more pointed pad
Others microPrint	Digging of the doctor blade	Use harder or thicker doctor blade Inclination of 5° - 15°

8.12 Small inclusions of air are visible

Problem Area	Possible Cause	Trouble shooting
Ink microPrint	Viscosity is too thick.....	Dilute
Cliché microPrint	Bad etching	Check plate with a magnifying lens, if necessary try new plate
Pad microPrint	Surface is damaged..... Wrong shape ..... Too soft	Use new pad Use more pointed shape Use harder pad
Material microPrint	Electrostatic charging..... Soiled by particles of dust.....	Mount ionization unit Pre-cleaning if necessary with blast of air
Others microPrint	Defect film..... Dust while film is being copied Soiled surroundings raising of dust	Check film Try new plate Pad may transfer particles of dust from the product into the ink, inclosions of air are pretended

8.13 Printings contours are not sharp

Problem Area	Possible Cause	Trouble shooting
Ink microPrint	Viscosity is too thick..... Viscosity is too thin..... Too slow	Dilute Reduction of the amount of thinner Use of a faster drying thinner
Cliché microPrint	Bad etching ..... Etching depth is too big ..... Wrong type of plate ..... Wrong type of screen	Check with magnifying lens, if necessary try new plate Try new plate with lower etching depth Use suitable type of plate Test new plate with a different screen
Pad microPrint	Too soft ..... Wrong shape	Use harder pad Use different shape
Material microPrint	Dirty surface ..... Drafts within the product ..... Printing near edges ..... Very uneven structure	Pre-cleaning with alcohol Switch over to other material if possible Fixtures must support the product near the edges Use harder and pointed pad
Others microPrint	Work piece fixtures are not stable enough High cycle times in combination with a large volume of the pad.	Try new fixtures Decrease speed if necessary delay in front position before releasing the film to avoid vibrations of the pad during printing onto the product

8.14 Printing image is blurred

Problem Area	Possible Cause	Trouble shooting
Ink microPrint	Viscosity is too thin..... Too slow	Reduce amount of thinner Use faster thinner
Cliché microPrint	Wrong etching depth ..... Wrong type of screen	Check depth, if necessary try new plate Check new plate with a different screen
Pad microPrint	Too soft ..... Too small volume ..... Prints over edges ..... Unequal pressure above cliché and product	Use harder pad Use larger pad Adjust pad stroke Adjust pad stroke
Material microPrint	Very uneven surface ..... No / insufficient pre-cleaning... Drafts within the product.....	Use pad mounting or special shapes Pre-clean surface Switch to other materials if possible
Others microPrint	Work piece fixtures are..... improperly attached Work piece fixtures are not..... stable enough Cliché not properly doctored	Fasten fixtures Try new fixtures see 8.36

8.15 Fine lines bleed into each other

Problem Area	Possible Cause	Trouble shooting
Ink microPrint	Viscosity too thin ..... Too slow; inks smear.....	Reduce amount of thinner Use faster thinner
Cliché microPrint	Etching depth too big ..... No stepped etching within fine motives Wrong type of plate	Try new plate with lower etching depth Only possible for hardened or band steel clichés Use different type ofcliché
Pad microPrint	Rough surface ..... Wrong shape	Use new pad Use steeper shape
Material microPrint		
Others microPrint	Pad stroke is adjusted too deep	Causes too strong deformations correct

8.16 Half-tone dots are visible

Problem Area	Possible Cause	Trouble shooting
Ink microPrint	Viscosity too thin ..... Too slow; inks smear.....	Thick ink in combination with fast thinner results in visible half-tone dots Thin ink in combination with slow thinner results in visible half-tone dots
Cliché microPrint	Etching depth is too big..... Wrong type of screen	Try new cliché with lower depth Depending on the desired result, use finer screen for invisible dots, coarser screen for visible dots
Pad microPrint	Rough surface ..... Wrong shape	Use new pad Depending on the desired result, use more pointed shape to achieve visible dots use more flatshapes to achieve invisible half-tone dots
Material microPrint	Very rough structure of surface	In this case the structure of the surface and not the half-tone dots are visible
Others microPrint	Film for copying is of poor quality	Check dot-lines if necessary try new film

8.17 Splatters at the edges

Problem Area	Possible Cause	Trouble shooting
Ink microPrint	Viscosity is too thick ..... Ink buildup at the pad	Dilute Use faster thinner
Cliché microPrint	Etching depth is too big ..... Wrong type of screen	Try new plate with lower etching depth Try new plate with a finer type of screen
Pad microPrint	Wrong shape ..... Rough surface	Use more pointed shape pad Use new pad
Material microPrint	Electrostatic charging of surface	Mount ionization unit
Others microPrint	Humidity is too low ..... Cycle time is too high ..... Printing sequence is irregular	Increasing humidity to 60-80% Reduce printing speed Maintain regular printing sequences

8.18 Colour does not correspond with template

Problem Area	Possible Cause	Trouble shooting
Ink microPrint	Viscosity is too thin ..... Wrong type of ink ..... Shade cannot be mixed	Reduction amount of thinner Use pad printing inks Use opaque shades
Cliché microPrint	Wrong etching depth ..... Wrong type of screen	Check depth, if necessary try new plate Try new plate with a different screen
Pad microPrint	Wrong shape ..... Rough surface	Use hard, pointed shape Use new pad
Material microPrint	Dark substrate	Try to obtain a thicker ink film by printing twice or more
Others microPrint	Only single print	Test double or triple printings

8.19 Distortion of the printed image

Problem Area	Possible Cause	Trouble shooting
Cliché microPrint	Incorrect motive was etched ...	Compare original and printed image by holding the film over the print if necessary correct and make new plate
Pad microPrint	Wrong shape ..... Too soft or too hard ..... Pressure is too strong ..... Unequal pressure over plate... and product Wrong point of touchdown too little volume.....	Use different shape Use different hardness Shorten pad stroke Correct pad stroke Use different point of touch-down of the pad Use bigger pad
Material microPrint	Very soft or elastic	Cool before printing causes more rigidity
Others microPrint	Unsuitable work piece fixtures	Modify fixtures to achieve support on all positions of the product

8.20 Index of multi-color printings does not fit

Problem Area	Possible Cause	Trouble shooting
Cliché microPrint	Index of different printing images does not fit	Try new plate with new film that is correctly indexed
Pad microPrint	Pads are not mounted..... centrally Unequal shapes..... Different hardness..... Uneven pad stroke over plate and product	Re-adjust Use equal shapes Use pads of the same grade of hardness Correct pad stroke
Material microPrint	Drafts within the product	Switch to other materials if possible
Others microPrint	Work piece fixtures are not..... stable enough Conveyor, shuttle or turntable move inaccurately Fixtures are insufficiently attached	Check production of new fixtures if necessary Check indexing Fasten screws of fixtures
  microPrint	x	x

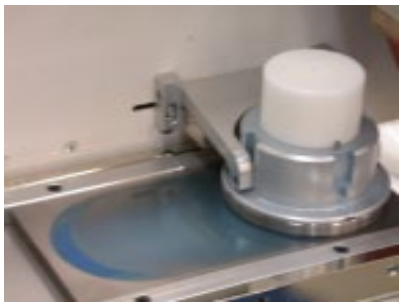
8.21 Ink film does not adhere to the product

Problem Area	Possible Cause	Trouble shooting
Ink microPrint	Wrong type of ink ..... Wrong/no hardener ..... Wrong/inexact proportion of mixing	Use suitable ink type according to the technical data sheet Add appropriate hardener to two-component-inks Exact weighing of ink and hardener is indispensable
Material microPrint	Dirty surface	Pre-cleaning with alcohol
Others microPrint	No/insufficient pre-treatment .. Required hardening period was not respected No/insufficient after -treatment	Check pre-treatment repeat if necessary Observe required hardening period Check after -treatment repeat if necessary
microPrint		

8.22 Cliché isn't properly "doctored"

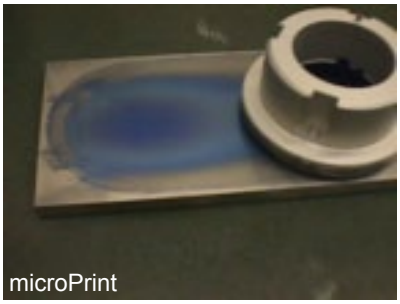
Problem Area	Possible Cause	Trouble shooting
Ink microPrint	Ink too thick..... Ink too thin..... No pad printing ink.....	Dilute ink Mix new ink Use pad printing ink
Cliché microPrint	Uneven..... Worn..... Warped..... Dirt under thin clichés.....	Use even cliché Use new cliché Check mounting Remove cliché, clean and re-mount
Cup microPrint	Worn..... Doctor blade edgedamaged... Not enough ink.....	Use new cup Use new cup Add ink
Racle microPrint	Worn..... Blade damaged..... not parallel to cliché..... too little blade pressure.....	Use new blade Use new blade Readjust blade Increase blade pressure

8.23 Simple Cliché and Cup Test



Not every ink type and tone can be removed from the cliché equally well. Especially the color blue can cause difficulties.

However, if cliché and pot are in order, the viscosity not too pasty, and the cliché not warped, you should obtain proper results with all pad printing inks.



There is a simple and good test for checking clichés and cups.

Remove the cliché from the cliché holder and set up cleaned cup.

Pour some gasoline or light oil into the cup.

Move cup by hand back and forth; then turn it a little and move it back and forth again.

If there are some spots on the cliché with a rainbow-like surface, which moved alone, when the cup was turned, then the cup is not in order.

If there are some spots on the cliché with a rainbow-like surface, which did not moved alone, when the cup was turned, then the cliché is not in order.

If there is no rainbow-like surface during this test, but the excess ink on the cliché still cannot be removed properly, then the inserted cliché is either warped or the ink is too thick.