# Choosing the Right Sublimation Transfer Paper


This article evolved from a diagram into a manual for choosing the right sublimation transfer paper, based upon the professionals' collective experience.

*Very few manufacturers offer transfer paper for inkjet sublimation inks. Yet, choosing the right type of paper is not as easy as one might expect. Printers have to find the right balance between printability, productivity and behaviour in the transfer press on the one hand, and the paper procurement costs on the other. Other issues need to be addressed: How important is transfer yield? When do I need "high speed" paper? An entrepreneur who is considering his first investment in digital transfer printing is confronted with other dilemmas, too: Do I choose a water-based system, or should I consider oil-based or solvent-based inks? Which type of paper is preferable for transfers onto metal or tiles?*

## Why This Article?

As a specialist supplier, Texo Trade Services carries a broad range of sublimation transfer papers. As our customers are entitled to objective advice, we wanted to describe the right paper choice in a simple diagram for us to use when advising them. When we showed the draft diagram to a number of dye sublimation experts, they encouraged us to provide more background information. Thus, this article evolved from a diagram into a manual for choosing the right sublimation transfer paper, based upon the professionals' collective experience. Unfortunately, it is not the simple diagram that we thought of at the outset. Rather, it is more complex.

## Summary

First, we shall discuss the fundamental choices for ink systems: water-based, oil-based or solvent-based.

Then we will provide a guide for water-based systems focussing on three aspects:

- transfer onto textile fabric versus transfer onto a hard substrate
- the "basis weight"- "high speed" versus "normal" transfer paper

Finally, we shall look at other aspects of the transfer printing operation because the right paper choice is by no means the only condition for successful transfer printing.

## Water-based Systems versus Oil-based and Solvent-based Systems

For many reasons, water continues to be the ideal carrier for sublimation inks. However, water and paper are not ideally suited for each other. Paper fibres absorb water by swelling. This mechanism poses an inherent problem for printing processes with water-based inks. Small variations in the amount of water can cause the paper to expand or shrink by as much as 1 percent or more. Such moisture variations not only occur as a result of the water-based ink being applied to the paper surface, but also because of variations in the air's moisture content in the print room, to the extent that the unpacked paper is exposed to them. The limited dimensional stability of paper as a function of variations in moisture content generally does not pose many problems with narrow printers and small sheet sizes. However, wide-format printing is an altogether different matter. A change of 1 percent in the web width amounts to as much as 2.5 cm (nearly 1 inch) or more across the full width!

Compared with water-based inks, oil-based inks cause less swelling of the paper fibres and none of the resulting problems, such as linear extension and cockling. For widths greater than 250 cm (98 inches), (see Figure 1, page 6) we advise our customers to consider oil-based systems but to take into account the following limitations.

## Limitations of Oil-based Systems

Printed transfer paper is made up of a highly unstable system. This is because the transfer paper delivers a maximum amount of dye to the substrate during the transfer process. Dye particles in the printed

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Figure 1: Grand Format printers from Vutek and Gandinnovations are used for sublimation transfer printing with oil-based inks at widths of more than 3 metres.


Figure 2: Small objects - the most popular application of sublimation transfer printing on hard surfaces.

paper must sublimate freely when exposed to heat in the transfer press. They must not be bound chemically or by any other means. Yet, before the transfer, the dye is not supposed to "migrate." These more or less conflicting demands make the system extremely vulnerable and susceptible to contaminants from the environment. Even certain components of the paper and the ink may cause problems. Unfortunately, the "oil" in the oil-based ink is such a component.

When an oil-based ink is drying, the oil does not evaporate from the paper. At most the volatile fractions will evaporate. The remaining fractions facilitate the paper dye's migration, causing colours to shift and details to lose their sharpness. Therefore, transfer paper printed with oil-based inks must be run through a transfer calender immediately after printing.

## Promise of Solvent-based Systems

Solvents hold the best promise of enabling wide-format printing systems without having the limitations associated with oil-based inks. Solvent-based systems would make a larger number of printing platforms available for dye subimation transfer.

There is a very good reason why solvent inks have not played a bigger role in sublimation transfer printing. Solvents bring environmental and safety hazards, which printers thought they eliminated when they embraced water-based sublimation inks. Printers with a background in the textile industry are accustomed to water-based ink chemistry, which has its own environmental problems. To them, water-based transfer printing provides a clean and safe business model. The situation in the sign industry is quite different. Solvent ink is the preferred method for producing outdoor graphics on uncoated, non-absorbent media. Sign printers are fully familiar with health and safety requirements. To the sign industry, solvent-based dye sublimation is not equivalent with new health and safety hazards.

It is too early to make recommendations about solvent-based sublimation transfer printing because there are still technical hurdles. However, we will be following developments in this new technology closely.

## Guide for Water-based Systems

Open Substrate (textile fabric) versus Closed Substrate (metal, ceramics) Transfer papers for textile fabrics are specially designed to deliver the maximum amount of dye to the substrate (maximum "transfer yield") during the pressing process, thus meeting the highest colouristic demands and allowing for the least ink consumption. Maximum-dye release occurs when carrier liquid and dye particles are not strongly absorbed into the paper and the dye particles are not bound to the internal paper structure. To achieve this, manufacturers have developed a closed film coating, which forms a gel with water from the printing ink. The barrier character of these coatings makes the papers less suitable for transfer to hard (closed) substrates. The vapour, generated when the paper is heated during transfer, can only escape in a lateral direction. This can easily cause damage to the print, which is visible in the cloudy vapour patterns in full colours and blurred contours. For transfer onto hard surfaces (see Figure 2), we recommend a transfer paper that allows the vapour to escape through the paper. This type of paper is similar to photo-quality inkjet papers, which dry immediately after printing. But there is a tradeoff. The dry paper surface is made possible by a special silicate-based coating, which draws the ink faster and deeper into the paper compared with the paper for textile fabrics. This results in a noticeably lower transfer yield. A second disadvantage of the hard-surface papers is that they cockle more easily due to the quick water absorption.

It should be noted that the hard-surface paper is popular with textiles and rigid surfaces in North America. Elsewhere textile printers generally prefer papers specially designed for soft substrates.

## The Right "Basis Weight"

Nearly all sublimation transfer papers for inkjet printing on the market today fit into one of the following weight categories:

- around 70 g/m2
- around 100 g/m2
- around 140 g/m2.

In the case of printing on open substrates, four criteria should be considered for the correct paper choice: Ink load, pattern difficulty, web tension control and printing speed.

### *Criterion 1 – Ink loading*

This is the general and dominant rule. The higher the ink loading, the heavier the paper has to be in order to accept the moisture from the ink without any problems. The relationship between ink loading and paper weight results directly from the water absorption by the paper.

*Criterion 2 – Difficult patterns*
*Difficult patterns demand heavier paper.*

What is a "difficult" pattern in this context? One that has:

- an asymmetrical design
- blotches or bands with little or no ink alternated with blotches or bands with a high ink loading

Difficult patterns pose a challenge for the paper's dimensional stability because they create big, local differences in the amount of ink that will be absorbed. At the borderline between low and high ink loading, the transfer paper has a tendency to cockle.

*Criterion 3 – Roll-to-roll or roll-to-sheet*

Roll-to-roll operation of the printer allows for a certain amount of tension control. Although the different types and makes of printers vary considerably in this regard, as a general rule roll-to-roll printing results in better process control than roll-to-sheet, in which the paper web is cut off immediately after the printing heads. Additionally, when the printed paper is processed from the roll in a transfer calender (see Figure 3), conditions are ideal for the use of a lightweight paper.

*Criterion 4 – Printing speed*

The higher the printing speed, the lower the paper weight can be. Cockling causes problems mostly when it happens directly beneath the printing heads (see Figure 4). The papers for open substrates are designed to slow the water absorption in the paper structure. From this, a higher printing speed takes the cockling away from the danger zone under the printing heads.

## When do I need "high speed" paper?

With the development of "high speed" or "HS" papers, manufacturers anticipate for the ever-increasing speed of the inkjet printers. These "high speed" papers, i.e. papers that dry considerably faster than the regular ones, meet the requirements of the latest generation of printers and even of tomorrow's printers. It is especially noteworthy that the faster drying is not obtained at the expense of the transfer yield. The HS paper fulfills the highest colouristic demands. Many print shops use the same colour profiles for "high speed" paper as they do for regular paper.

Regular transfer papers for open substrates typically show a gradual, ink absorption and dry relatively slowly. Transfer printers have adjusted to this phenomenon in different ways. In many cases, the slow drying does not pose a problem, even on fast inkjet plotters. Printers fall back upon a box of tricks to make sure that the paper is dry and, more importantly, smear-resistant before it is wound-up. The oldest and simplest trick is extending the paper path in the printer. This often is done by simply putting the rewind on the same side of the printer as the unwound, and by installing some extra rolls to guide the web underneath the printer. Sometimes, you see a separate winding stand at a short distance from the printer. Another solution is a heated plate under the printed paper that is sometimes combined with a heated plate before the printing heads. In many cases, an array of fans is used for additional convection drying. The above-mentioned tricks are so widely used that they are standard features on many printers.

After HS transfer paper made its appearance onto the market, ink manufacturers introduced similar "high speed" inks. All elements of transfer printing seem to be advancing in parallel with production speeds, be it the print heads, printers, paper or ink. We shall dedicate a separate article to the advances in sublimation inks sometime in the future.

Figure 3: Roll-to-roll transfer in a transfer calender.

Figure 4: Alternating dark and light bands. Note the cockling at the borderline.

Photo courtesy of Campo Coprint BV

The latest printer models are so fast that the limits of the various tricks are visible, particularly with print work done with high ink loading. HS transfer paper is the obvious solution because it halves the time needed for the image on the paper to dry and become smear-resistant. However, we always advise our customers to first make a detailed cost analysis. "High speed" paper costs about 10 cents per square meter more than the equivalent "standard" paper. Have all options been exhausted in reaching the desired printing speed? Does higher output justify higher media expense? Is it possible to accept a lower printing speed combined with lower media costs?

## Other Matters

The above guide helps professional transfer printers select the right paper and

Printers fall back upon a box of tricks to make sure that the paper is dry and, more importantly, smear-resistant before it is wound-up.

allows them to focus on more important parts of their business. However, before doing so, they should pay attention to two technical matters, which may cause them to use more expensive consumables than necessary: Colour management and temperature and humidity control in the press room.

Colour management — in other words things such as linearization, finding the proper settings and making and using ICC colour profiles — forms the basis of a professional workflow. Colour management guarantees a controlled process with reproducible output. This is a necessary condition for the optimal procurement of consumables to achieve quality improvement and cost reduction. Without good colour management, any media or ink experiment becomes a risky venture, condemning the printer to use more expensive consumables.

The other technical matter is climate control or rather the lack of it. In the commercial printing industry controlling the temperature and the relative humidity of the air is taken for granted. Many litho printers know what temperature and relative humidity they need in the press room. This awareness is quite different in transfer printing. Sublimation transfer printers working with water-based inks know from experience that print heads become clogged easily in a dry environment. They are less aware of the negative impact of high relative humidity and of substantial changes in relative humidity on the paper's productivity. Certain complaints about the paper at the end of each summer illustrate this. When the outside temperature drops — but the heating system is not yet switched on — the humidity in the press room goes up, causing all sorts of problems with the printing paper. These problems and complaints disappear when the outside temperature drops further and the room-heating systems are on.