LASER FOCUS

Gérard Rich delves into computer-to-plate imaging technology and offers advice on choosing the right CTP system to meet all your needs

Printing is diverse in terms of the definition of printing forms and applications. It is therefore important for printers to look for the adequate preparation tools combined with the best choice of imaging technology. There are computer-to-plate (CTP), or computer-to-screen (CTS) devices that are hybrid in nature, optimised for any applications in terms of imaging resolution and imaging methods.

Different imaging systems are necessary to cover the needs of industrial, screen, pad, graphic and textile printing. In particular, high resolution imaging (up to 10,160 dpi) of silk screens with UV lasers and specialised software push the limits for demanding applications. Automation is called on to minimise human intervention in order to reduce both cost and process vulnerability. For instance in pad printing, where four different types of printing plates are used, there is a need for a technology offering many imaging wavelengths in combination with software tools and high resolution.

Lüscher's laser imaging technology offers four wavelengths for UV direct processing (375/405nm) or for thermal/ablation processes (830/940nm) and any resolution you can think of. Two different laser types can be incorporated in one system to address a broad set of needs.

INTRODUCTION

Prior to the advent of computer-to-plate, most printing forms were (and still are for the most part) UV sensitive and had to be imaged under UV light frames. As CTP was introduced in the 1990s, there were no affordable UV lasers that could process plates, and printing materials had to be adapted so that they could be processed with thermal or ablation lasers. Over time, the CTP landscape complexified itself as more types of printing forms went 'digital' and UV lasers finally became affordable.

'Over time, CTP systems have been improved to address demanding customer needs'

We will start by presenting a comprehensive analysis of the various imaging technologies relevant for the reader, how CTP systems address these needs and how recent improvements help pushing the limits. Finally, we will underline that there is always one optimal solution for any combination of needs.

SEGMENTATION OF IMAGING TECHNOLOGIES

First of all, we need to distinguish between thermal and UV lasers processes. Thermal processing lasers calling on IR (infrared) can only heat up potentially sublimate materials, whereas UV lasers can trigger chemical reactions, as is the case under a light frame. In offset printing, the thermal process (830nm) is primarily used, whereas ablation (940nm) is mainly applied to relief printing applications. The situation is more complex for pad printing for reasons we will explain in detail later on, and UV lasers hold a monopoly in the field of silk screen and photoresist applications.

Exhibit I gives an overview of imaging technologies used for six different printing forms relevant here. We distinguish between mainstream technology in the industry and availability of technology, i.e. having either a niche or an emerging status.

Historically, three wavelengths established themselves in the field. Thermal processes have a standard wavelength of 830nm. Ablation lasers were introduced at a later date and usually have a longer wavelength. We use 940nm as the laser power is higher at this wavelength. Initially, UV lasers were developed for the electronic industry with a wavelength of 405nm. Being only ten years

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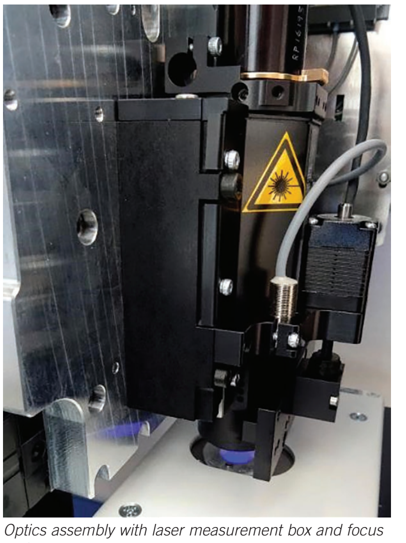
BOX 1: BASICS ABOUT THE LÜSCHER LASER IMAGING SYSTEM

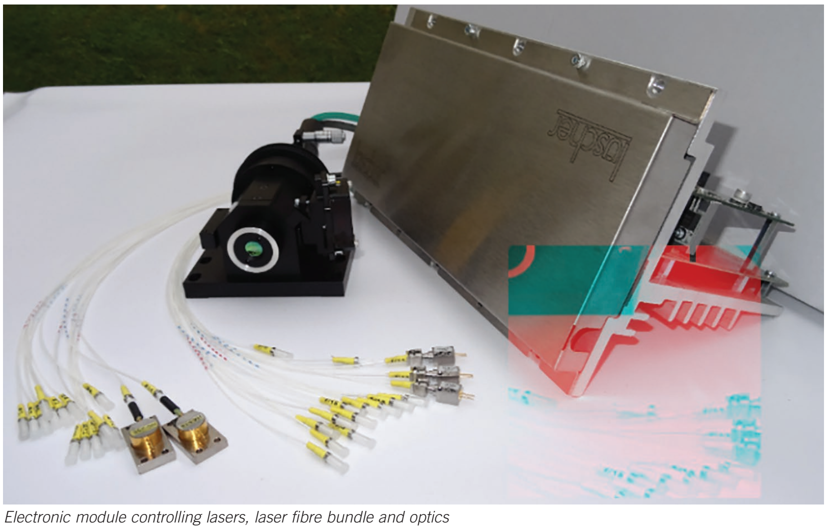
The Lüscher system is based on digitally controlled laser diodes. They scan the surface of a printing form in order to directly harden, destroy or ablate polymers. The individual laser diodes, coupled to optical fibres, bring the energy to the raster plate and the optics.

The energy is transferred via optical fibres and focused onto the surface of the printing form by the optics.

Fibre-coupled UV diode



Optics assembly with laser measurement box and focus system



Electronic module controlling lasers, laser fibre bundle and optics

BOX 2: SOFTWARE IMPROVEMENTS FOR CTP IMAGING

Customers keep asking for improvements and systems benefit from continuous software development. Two examples are explained in detail in this section:

Variable resolution systems

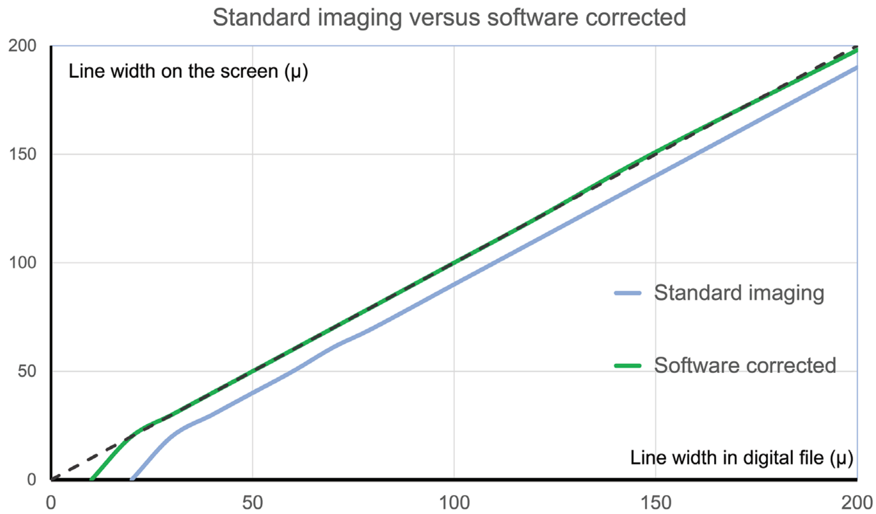
A key trend is the increase of imaging resolution to obtain a more accurate reproduction of digital data. For instance, systems imaging screens at a resolution up to 10,160 dpi have been recently introduced mainly for electronics. However, customers do not want to compromise on speed and ask for systems providing both high resolution for high end jobs and lower resolution to keep a high throughput for standard jobs. This is made possible by adequate software options.

Imaging of fine details

Imaging of very fine details is explained using the example of screen printing, but it also applies to photo resist applications and others. Customers have been pushing us to improve the imaging quality for fine printing elements to meet very stringent requirements. Therefore, we first had to understand what caused the deviations and then had to develop means to fix them.

To understand and to quantify deviations in imaging, we designed a special test file having line thicknesses from 10–200 microns in steps of 10 microns in relevant directions of space. Lines are used because their width can be properly measured under a microscope and results can be transposed to any other graphic element. The file was used to image screens with several high-performance emulsions from different suppliers on different mesh types. The outcome was evaluated quantitatively by microscope measurements of actual line widths generated on screens. This created a clear pattern that points in one direction.

The typical result on screen emulsions for fine graphics applications is illustrated in this graph. The job was imaged on a MultiDX! equipment at a resolution of 5080dpi. On the horizontal axis, the graph has the theoretical (negative) printing line widths in the TIFF file. The actual line widths with standard imaging (blue curve) and software corrected imaging (green curve) on the screens are illustrated on the vertical scale.



Graph showing standard vs software-improved imaging of capillary film

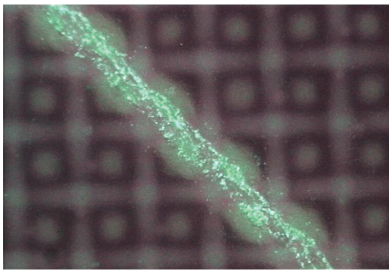
The results are analysed as follows:

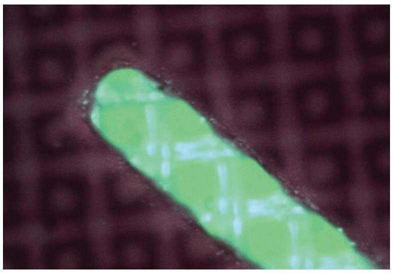
There is a gap between the actual line width and the theoretical width (dotted line) in the standard imaging procedure that is significant. There is a lower limit of imaging at about 40 microns as thinner lines are not developed properly. The result on the same screen emulsion with software correction shows an almost perfect correction of the line widths.

The lower limit of imaging is pushed down to 30 microns. The improved software enables a faithful reproduction of digital data and also allows the reproduction of finer lines.

At the other end of the demand spectrum, the improved software pushed the limits for imaging thick capillary films.

With standard imaging procedures, even at high resolution, the light scattering and light diffusion in the film is limiting the imaging capability on the low end of graphic element sizes. Here again, software corrected imaging makes a huge difference.





Example of a 300-micron line of a 100-micron capillary film imaged at 2,540dpi. Top: standard imaging procedure (line not developed). Bottom: software-improved imaging (correct line of 300 microns)

old, 375nm wavelength lasers represent a fairly young technology. CTP builds on these new developments. Exhibit I underlines that the bulk of product types can be imaged with UV lasers. Because of the variety of imaging wavelengths, imaging of a set of printing forms may need more than one laser source. This has consequences for the CTP design.

LÜSCHER IMAGING SYSTEM

Right from the beginning of the CTP journey, Lüscher opted for a modular imaging system consisting of up to 128 diodes controlled by digital data at individual level. The laser energy is transported by optical fibres and collected onto a raster plate. The image created on the raster plate is reduced in size by the optics focusing the beams onto the print to be imaged. (See **Box 1** for more details.)

This architecture generates a set of valuable options. First, the diameter of the optical fibres and the characteristics of the optics with its variations allow the generation of any imaging resolution, almost at will.

Second, the system is compatible with any diode being either of the IR or UV type.

Third, two laser types can be combined in one system. Therefore, it is easy to mix any UV imaging process with any thermal or ablation process in one CTP. With four imaging processes and at least three laser types, the list of relevant combinations is considerable.

THE RIGHT CTP FOR YOUR NEEDS

Any printer must answer critical questions related to the choice of CTP. The first selection criterion is whether a flatbed system is mandatory. Drum systems can only accommodate flexible printing forms. The second criterion is whether UV and IR

Imaging process type and laser wavelength		Print form imaging - CTP type and resolution range (dpi)											
Type	Laser wavelength (nm)	Silk screen		Pad printing plates		Relief printing plates		Photoresist applications		Offset plates		Textile printing screens	
IR Ablation	830 up to 1064	-	-	External drum Internal drum Flatbed	2400 to 5080 dpi	External drum Internal drum Flatbed	2400 to 5080 dpi	-	-	External drum Internal drum Flatbed	2400 to 5080 dpi	-	-
IR Thermal	830	-	-	-	-	-	-	-	-	External drum Internal drum Flatbed	2400 to 12000 dpi	-	-
UV polymer degradation	405	-	-	-	-	-	-	Flatbed	2400 to 12000 dpi	External drum Internal drum Flatbed	2400 to 12000 dpi	-	-
UV polymer crosslinking reaction	405	Flatbed	635 to 12000 dpi	External drum Internal drum Flatbed	2400 to 5080 dpi	External drum Internal drum Flatbed	2400 to 5080 dpi	Flatbed	2400 to 12000 dpi	External drum Internal drum Flatbed	2400 to 12000 dpi	External drum Flatbed	1200 to 2540 dpi
UV polymer degradation	375	-	-	-	-	-	-	Flatbed	2400 to 12000 dpi	External drum Internal drum Flatbed	2400 to 12000 dpi	-	-
UV polymer crosslinking reaction	375	Flatbed	635 to 12000 dpi	External drum Internal drum Flatbed	2400 to 5080 dpi	External drum Internal drum Flatbed	2400 to 5080 dpi	Flatbed	2400 to 12000 dpi	External drum Internal drum Flatbed	2400 to 12000 dpi	External drum Flatbed	1200 to 2540 dpi

IR Lasers — Mainstream process
UV Lasers — Niche or emerging process

Exhibit I: mapping technologies and applications

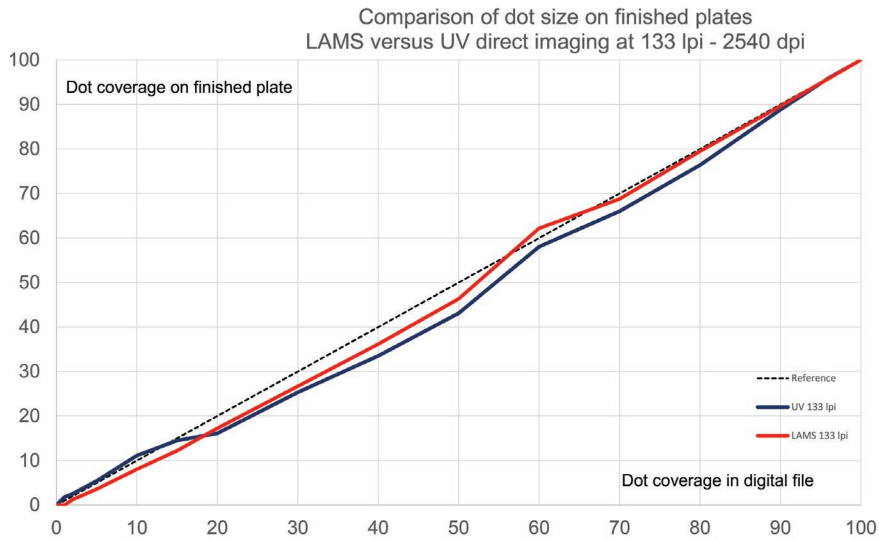


Exhibit II: comparison between LAMS and direct UV imaging for flexo water wash plate

BOX 3: JETSCREEN LT

The JetScreen system for large format digital imaging of screens offers imaging resolutions from 635 up to 5080dpi (depending on size); standard TriOptic system 635/1270/2540dpi; full in-line process automation if required; high power lasers to completely harden any emulsion; throughput up to 45m²/hour; low maintenance and operating costs.

Applications for: printed electronics, automotive, glass printing, transfer printing, labels and industrial screen printing.

Lüscher's JetScreen LT exposure system

are needed for the combination of needs considered. The third element is about the resolution range expected and the maximal size of forms (both are obviously correlated). Other options:

- If compatible with the need, a drum machine will always be faster than a flatbed system
- Exploration of the possibility to switch to another printing form technology to simplify the CTP design.

Over time, CTP systems have been improved to address demanding customer needs and this leads to important options, such as:

- Multiple resolution systems
- Software improvements of imaging of silk screens and photoresists

(To keep the text fluid, these options are presented in more detail in **Box 2**.)

IMAGING PROCESS LANDSCAPE

The processing options for silk screens, pads, photoresist and relief printing plates are presented next as they will influence the selection of the best CTP option.

Silk screen imaging

There are two main options that must be distinguished: for large format, vertical flatbed equipment is mandatory. (See **Box 3** for details on Lüscher Technologies' JetScreen LT exposure system.) For demanding applications with tight registration needs and high resolution, a horizontal flatbed system (such as MultiDX!) is preferable.

Figure 1 shows 20-micron lines on a steel mesh screen imaged at a high resolution and viewed under a SEM. Such a result is out of reach of an equipment operating with 'standard' resolution. (See **Box 2** for more details.)

Textile printing screens can be imaged with either flatbed or rotary UV CTP systems.

Pad printing forms

There is a choice of four imaging processes. These will be presented later on in sequence.

Lams ablation is a spin-off of relief printing. A carbon mask is ablated by IR lasers to

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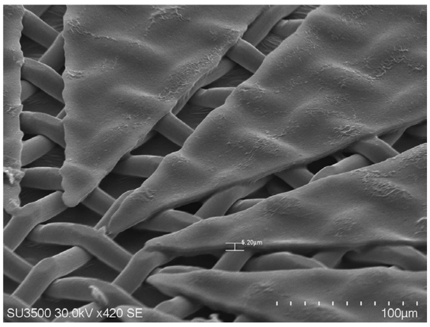

Figure1: 20-micron lines imaged at 10,160dpi

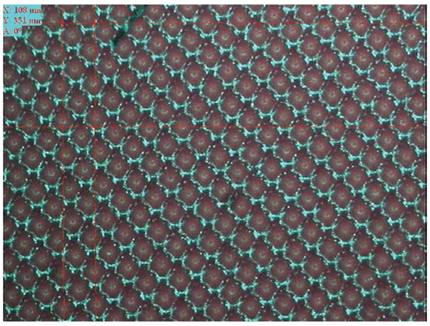

Figure 2: pad printing LAMS plate solid area

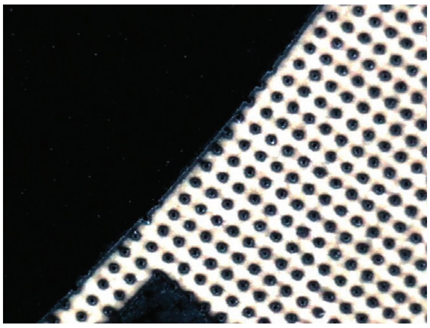

Figure 3: pad printing DLE plate

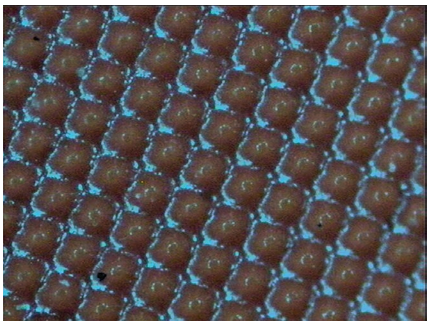

Figure 4: pad printing UV-exposed alcohol developed

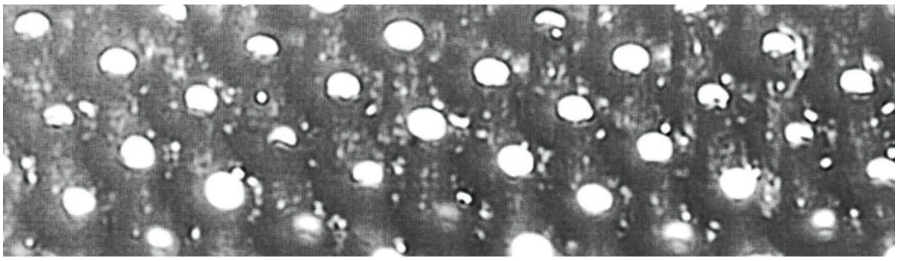

Figure 5: pad printing plate UV-exposed 3D view

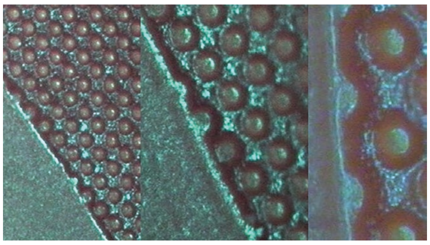

Figure 6: pad printing UV-exposed water wash plate

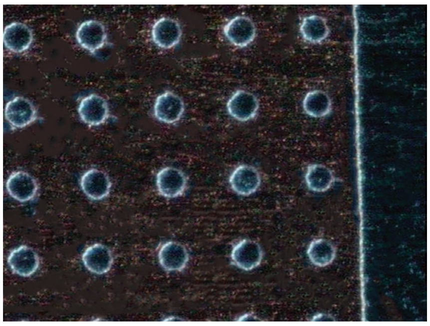

Figure 7: imaged protoresist plate

Figure 8: steel-based pad printing plate

Figure 9: imaged photoresist on magnesium plate

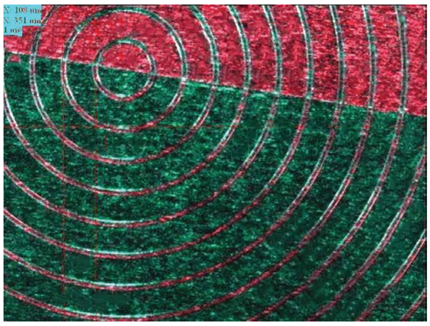

Figure 10: laser imaged photoresist coated on copper

create the equivalent of a film on the plate subsequently imaged under a light frame. **Figure 2** shows a microscope picture of a mask ablation pad printing plate – solid printing area.

Direct gravure (by ablation) is a recent development. IR lasers burn the pad printing cells into a special type of polymer. This comes close to a process-less system. **Figure 3** shows a microscope picture of a direct gravure pad printing plate – solid printing area. With the direct UV process, the polymer is selectively hardened by UV lasers. There are three options: **Figure 4** shows a pad printing plate processed by direct UV exposure and washed out with alcohol. See **Figure 5** for a 3D view of a different UV plate of the same type. High cell depth shown here. Figure 6 shows a polymer plate processed by direct UV exposure and water-washed – cell depth 100 microns.

Long-life pad printing plates made by etching of steel plates incorporate a photoresist layer that is imaged with UV lasers and developed. The plate is subsequently etched. See **Figure 7** for an imaged photoresist on a steel plate – 40-micron non-printing dots before etching.

Figure 8 is a view of the etched steel plate ready for printing.

Photoresist imaging

There is a range of applications including direct laser writing of conductive tracks, electroforming, wafers, etching, hot foil lamination, embossing, Intaglio, etc.

Figure 9 shows a laser imaged photoresist plate for hot stamping or embossing.

Figure 10 shows 20-micron lines on a laser imaged copper plate coated with photoresist.

Relief printing plates imaging

This covers flexo, letterpress and related applications. Relief plates can be imaged for the bulk using the LAMS ablation process. Except for SBR-based flexo plates, which are sensitive to oxygen inhibition, any relief printing plate can be exposed by the UV direct imaging process. See **Exhibit II** showing imaging results on both LAMS and UV plates presenting almost identical results.

CONCLUDING WORDS

There are two general trends that are transforming our industries. Customers have more and more demanding needs, and digital exposure of printing forms has become common use. This makes the choice of CTP (or CTS) more complex. With a set of criteria, however, it is possible to come to the optimal choice of CTP meeting all particular needs. ■

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