LithostarPlus LAP-R : a new red-sensitive silver DTR plate system for CTP imaging

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Abstract

In this paper the most recent evolutions in litho printing plate technology for computer-to-plate imaging are briefly discussed. A new silver diffusion transfer reversal printing plate system is introduced that allows imaging on any platesetter with a low-cost laser diode at 650 or 670 nm or even a HeNe laser at 633 nm. The performance of this new plate, called LithostarPlus LAP-R, is analyzed in detail. It is shown that this plate system performs in a way that is superior to what is known or claimed today for this kind of silver halide printing plates. Finally, it is demonstrated that this plate system offers a good solution with regard to both quality and cost for a number of applications.

Overview of the present CTP landscape

When we look at the present computer-to-plate landscape, we are confronted with a vast variety of plate technologies and imaging hardware concepts. Not surprisingly, for an emerging new application area that requires new innovative technology and lacks standardization, quite a number of companies have developed their own ideas into product and system offerings. The result is the heterogeneous picture we see today, which comprises plate and platesetter products with quite different characteristics and requirements and with a number of incompatibilities amongst them.

Let us take a closer look at the present digital litho printing plates. They come in all kinds of "colors and flavours". Silver halide diffusion transfer, photopolymer and hybrid plates are sensitive to visible laser light, ranging from blue to red. They are all called 'high sensitivity' plates, still their absolute sensitivity values span a range of 1 to 250 approximately, with silver halide plates requiring the least energy.

Agfa offers 2 types of aluminum based digital printing plates to the market today : (i) Ozasol N90A, which is a photopolymer type of plate that is green and blue sensitive;(ii) LithostarPlus, which is a silver halide diffusion transfer type of plate that comes in 3 versions : LithostarPlus LAP-B (blue sensitive), LAP-O (ortho-chromatic or green sensitive) and LAP-R (red sensitive). The red sensitive version has only been introduced recently and is the subject of this paper. Agfa also offers a polyester based digital printing plate to the market today : Setprint, which is also a silver halide diffusion transfer reversal type of plate that comes in 2 versions : Setprint-HN (red sensitive) and Setprint-IR (infrared sensitive).

Before we look into the details of LithostarPlus LAP-R plates, we should broaden our view a little furhter. Indeed, in addition to the above mentioned 'visible light' or more general photo-mode plates, a new family of digital printing plates is currently introduced to the market and they catch a lot of attention : so-called thermal plates. Thermal plates have as a common denominator their sensitivity to an (imagewise) applied rise of temperature, which is induced by infrared laser radiation. We could also call them heat-mode plates. Different imaging technologies are used : some thermal plates are based on photopolymer technology, other plates are based on ablation or ablation transfer and still other plates have physical insolubilisation as their working principle. Some need wet processing, others are (almost) processless. The best-known representative of this family of plates is probably the Kodak/IR® thermal plate, which is a photopolymer type of plate that requires a pre-heat step after imaging, followed by a conventional wet processing and optional post-bake step for achieving higher run lengths. Thermal plates are in general sensitive to radiation in the range of 830nm up to 1060nm, with absolute sensitivities that are about 50,000 to 500,000 times lower than what is known for silver based digital printing plates. Thermal plates and plate technologies carry some interesting and promising characteristics. They offer the outlook for future (completely) processless platemaking in a daylight environment. Other benefits could be : a very high resolution and run length capability. However, they also have some disadvantages today. Thermal plates require high energy density levels. Technically, this is possible thanks to the important progress that has been made in the field of high power infrared laser technology and optical

engineering. Today multi-Watt IR-lasers are available with a reasonable stability and life time. However, their cost is still significant. But for some applications (especially 8-up and 16-up) we believe there is definetely a market for thermal plate systems.

In Agfa's opinion, digital platesetting systems that use visible light sensitive plates still offer and also will offer in the future a better solution for a number of applications. That is why Agfa continues to invest in visible light sensitive digital plates and why Agfa developed its red sensitive version of LithostarPlus. We will elaborate further on this after the description of the plate and its performance.

LithostarPlus LAP-R

As stated before, LithostarPlus LAP-R is the red sensitive plate member of the new Agfa LithostarPlus plate family. The former Lithostar plate system was introduced about 3 years ago and only consisted of a blue and a green sensitive plate[2]. The new LithostarPlus system has been improved considerably with regard to several characteristics.

LithostarPlus plate construction

The LithostarPlus plate consists of 3 layers on top of an electrochemically grained and anodised aluminum substrate (see Figure 1). These 3 layers are coated in one single pass through the coating alley. This multilayer coating technology is very similar to the technology used for coating graphic arts film and it enables us to optimize the performance of the plate because it allows us to bring in specific functionalities in separate layers (one of Agfa's core technologies).

The aluminum substrate we use has received a silver nuclei surface after-treatment (nuclei with a diameter of only a few nanometers). These nuclei have a silver receptive function and guarantee a very good anchorage of the final silver image to the aluminum substrate.

Under the light sensitive layer is a specially developed barrier layer that garantuees the complete removal of all layer remainders in the non-image parts of a processed plate, so that they cannot have any impact on the lithographic performance of the plate[1] . At the same time this layer contains light absorbing components, which suppress the impact of reflections on and in the anodised aluminum substrate. As a result the plate has a very high resolution.

The top layer serves several purposes. First of all, it is a protective layer for the light sensitive layer and as such it also contains polymer spacer beads with a diameter of 6 um. These spacer beads were specially selected in order to avoid any adverse effects on the plate resolution. The top layer of LithostarPlus LAP-R also contains a dye that strongly improves the darkroom working conditions for this plate. As a result LithostarPlus LAP-R can be handled in comfortable green light conditions (comparable to normal red dark room conditions).

It is important to mention here that also the aluminum substrate has been optimized for the LithostarPlus plate technology. Both the electrochemical graining process and the anodisation process have been optimized and fine-tuned for the silver diffusion transfer reversal imaging technology.

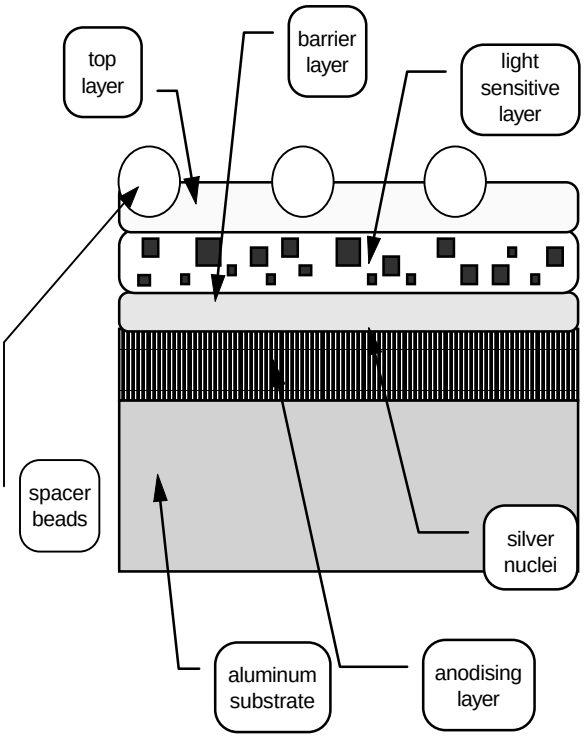

Figure 1: LithostarPlus plate construction

LithostarPlus working principle

The working principle of LithostarPlus is monosheet silver halide diffusion transfer reversal. The essence of this imaging technology is the formation of a silver image in the non-exposed parts at the surface of the anodising layer. As a consequence LithostarPlus plates are positive working plates. The silver receptive nuclei layer guarantees a good anchorage of this silver image to the aluminum substrate. We now explain in detail how this silver image is formed.

Step 1: Exposure

When a LithostarPlus aluminum plate is exposed, the silver halide particles in the exposed areas of the photosensitive emulsion layer are activated. These activated particles make up the latent image in the emulsion layer.

Step 2: Chemical development

During development, the exposed silver halide particles are developed and fixed inside the emulsion layer. They no longer play an active role in the formation of the final printing silver image on the plate.

Those silver halide particles that were not exposed to light will dissolve in the developer,which contains thiosulphate ions $S_2O_3^{2-}$ as a silver halide complexing agent, so that they get very mobile and diffusion can take place towards the aluminum surface. These particles will finally

form the printing silver image on the plate.

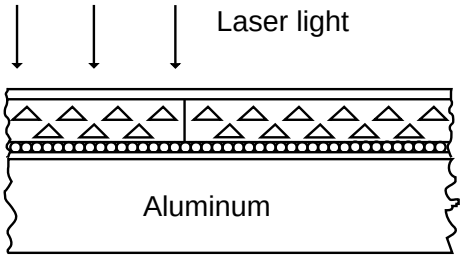

Fig.2 : Exposure

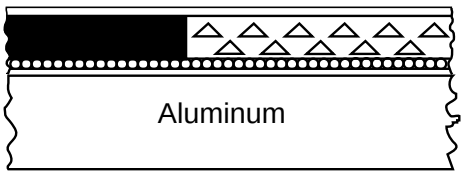

Figure 3: Development

Step 3: Diffusion and physical development

The unexposed silver halide will transfer from the emulsion layer down to the aluminum base, through the barrier layer and finally reach the silver receptive nuclei layer. There they will develop physically and form a silver image.

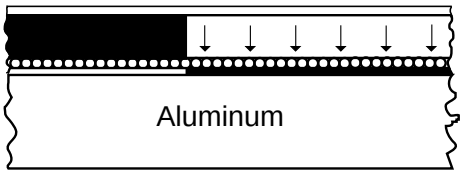

Figure 4: Diffusion and physical development

Step 4: Wash off

After the image formation, the emulsion and the water soluble barrier layer are completely removed, leaving only the final image on the aluminium substrate. The barrier layer guarantees the complete removal of all layer remainders, both in the image and in the non-image parts of the plate.

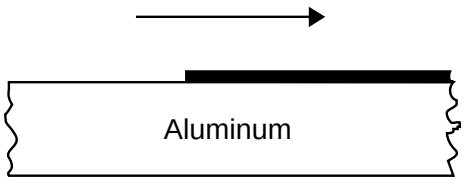

Figure 5: Wash off

Step 5: Finishing or gumming step

Not only does the final finisher treatment ensure optimum ink acceptance of the image areas, it also provides optimum gumming of the plate for proper conservation.

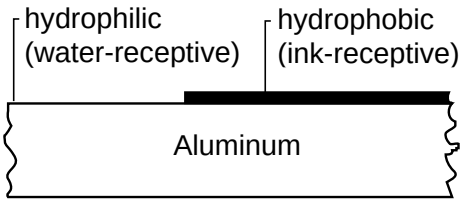

Figure 6: Finishing or gumming step

The process of silver halide diffusion takes about 30 seconds, the finishing step about 20 seconds.

LithostarPlus LAP-R plate performance

(1)Spectral sensitivity - absolute sensitivity

The spectral sensitivity curve for LithostarPlus LAP-R is shown in Figure 7. The absolute sensitivity is about 33 mJ/m^2 at 670nm and about 55 mJ/m^2 at 650 nm. The absolute sensitivity is still about 100 mJ/m^2 at 633nm. This means that the plate is sensitive to both red laser diodes and a HeNe gas laser. The plate can be handled under green safelight conditions (2 wrappings of a V505 filter and 1 wrapping of a neutral density filter of D=0.6).

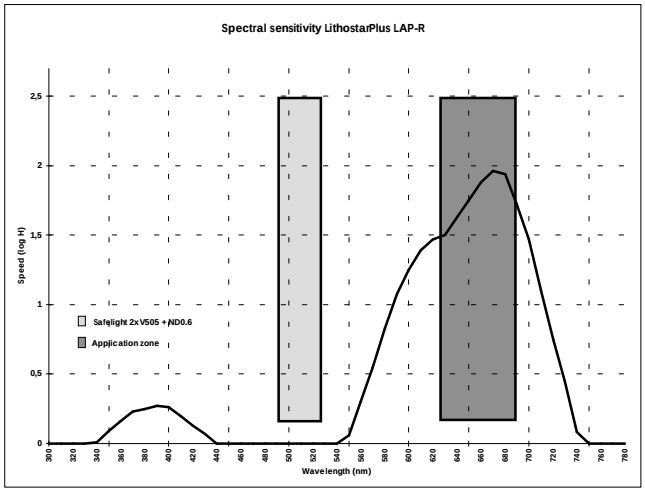

Figure 7 : Spectral sensitivity curve of LAP-R

(2)Resolution, image quality and exposure latitude

Both the resolution, the image quality and the exposure latitude of the LithostarPlus LAP-R plate are very comparable to this of the Agfa Alliance HN recording film. The results shown in Figs. 8 and 9 illustrate this. Both LithostarPlus LAP-R plates and Alliance HN recording film were recorded at 2540 dpi on a Gerber Predator platesetter, which is equipped with a 670nm red laser diode. We made an exposure series of ± 0.15 logH around the "right exposure" (RE) for both media. The right

exposure for LAP-R is defined as the exposure that results in the best possible linear reproduction on the plate. Each piece of Alliance HN film that we made was then subsequently contacted onto an Agfa Ozasol P51 positive working plate. Here we first made an exposure series and found out that for a given exposure setting on our contact frame a linear reproduction is obtained on the plate. We then used the same exposure setting for making all Ozasol P51 plates. All plates were finally printed on a one-colour Heidelberg GTO52, equipped with a Dahlgren film dampening system, on gloss-caoted paper. The ink/ fountain combination used was BASF K+E 197/Rotaprint Rotamatic. The solid ink density is 1.85 (according the BVD/FOGRA standards) as measured with a Gretag D186 densitometer with polarising filter.

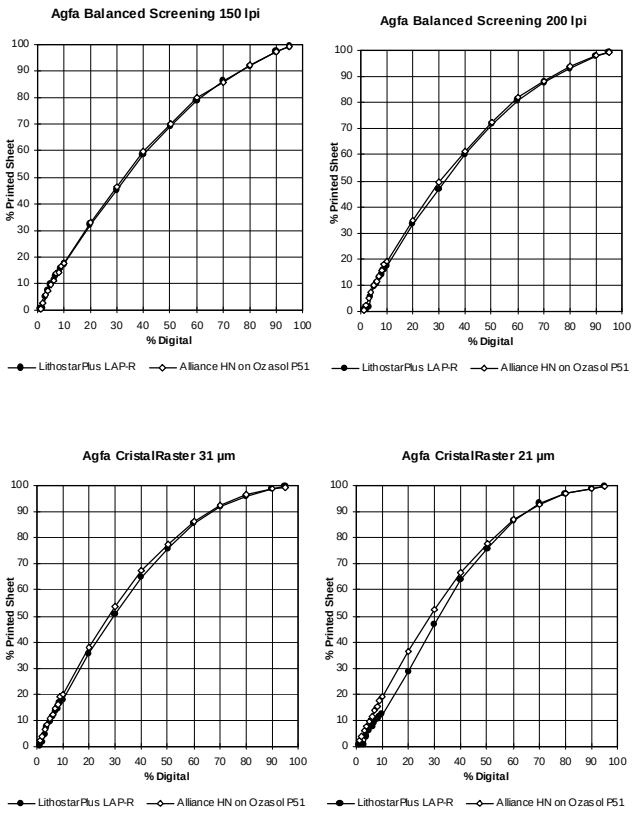

Figure 8 : Printing tone reproduction curves for LithostarPlus LAP-R and Alliance HN +Ozasol P51

From Fig. 8 and Tables 1 and 2 it is clear that the resolution of LithostarPlus LAP-R is excellent. The tone range of 2%-98% at 150lpi is in accordance with a resolution of 6 to 7 um. It is possible to get an even higher tone range by making use of halftone calibration. LithostarPlus LAP-R plates can be used for printing FM-screened images with microdots as small as 21um (2x2 pixel micrdots at 2540dpi). From Fig. 9 it is clear that the exposure latitude of LithostarPlus LAP-R is even better than this of Alliance HN recording film!

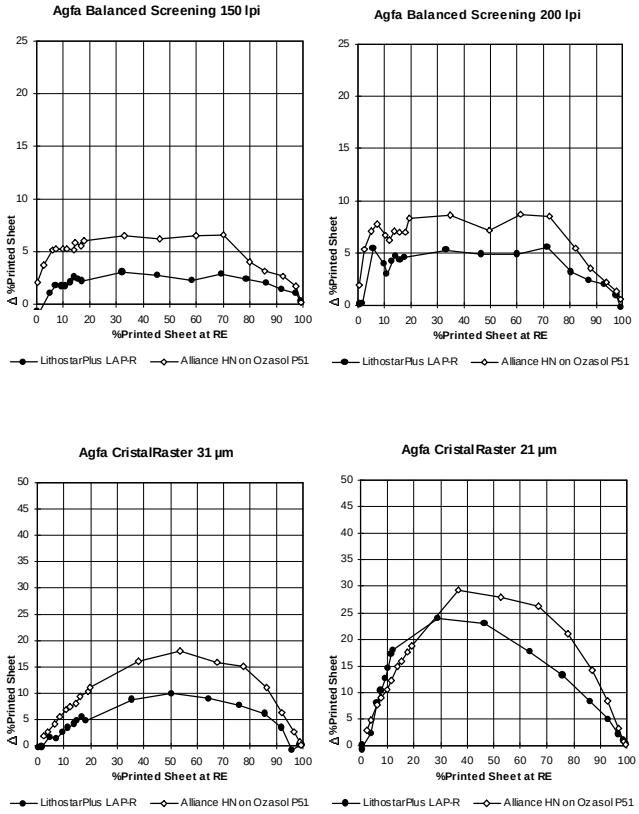

Figure 9 : Difference in tone reproduction on the printed sheet between underexposed (-0.15logH) and overexposed media (+0.15logH) (relative to the tone reproduction at the right exposure)

	LithostarPlus LAP-R	Alliance HN + Ozasol P51
Plate: tone range at 150lpi ABS	**2%-98%**	**2%-98%**
Plate : tone range at 200 lpi ABS	**3%-97%**	**3%-97%**
Plate: CristalRaster 21 um possible?	+	+
Plate: CristalRaster 31 um possible ?	+	+

Table 1 : Image Quality LAP-R (plate)
(magnification 8x loupe)

(3)Run length capability

In a run length test up to 300,000 impressions on a Heidelberg MO one-color press, equipped with an alcohol dampening system, only a shift of about 1% in the highlights took place (i.e. 2%→3% at 150lpi ABS and 3%→4% at 200lpi ABS) (ink/fountain combination : K+E 171/4% Anchor Aqua-Ayde + 3% Anchor Tame). The rendering of the midtones and the shadows was perfectly stable during the complete press run, showing no loss at all.

Run lengths with LAP-R up to 410,000 impressions have been reported so far at customer sites.

	LithostarPlus LAP-R	Alliance HN + Ozasol P51
Printed sheet : tone range at 150 lpi	**2%/3%-94%**	**2%/3%-94%**
Printed sheet : tone range at 200 lpi ABS	**3%-92%**	**3%-92%**
Printed sheet : CristalRaster 21 um possible ?	**+**	**+**
Printed sheet : CristalRaster 31 um possible ?	**+**	**+**
Printed sheet : 50% digital at 150lpi	**70%**	**70%**

Table 2 : Image Quality LAP-R (printed sheet)
(magnification 8x loupe)

(4)Miscellaneous

Other important characteristic of the plate is its relatively high plate contrast : D_{max} = 1.1/ D_{min} = 0.27, which allows a better image inspection and more reliable plate measurements than the first generation Lithostar plates LAP-O/B.

LithostarPlus system

As stated before, LAP-R is the red sensitive plate of the second generation LithostarPlus plate family. LithostarPlus is however more than a family or assortment or plates, it is a system, which comprises e.g. also the LP82 (plate widths up to 82cm) and LP150 (plate widths up to 150cm) processors. These dedicated processors ensure reliablility and convenience and can be linked to most platesetters with the use of a universal on-line bridge.

Both processors have a clearly structured, menu-driven control panel that allows the operator to pre-program the processor to be switched on and off during active and inactive periods. In addition, the processor routinely keeps track of historical data and monitors plate and chemistry consumption. Routine maintenance is kept at a minimum and no special tools are needed for system maintenance and cleaning. In addition, service technicians are guided by built-in, partially automated service programs that include automated self-diagnosis capabilities. The thoughput speed of the LithostarPlus processors LP82 and LP150 is 2.5cm (or 1 inch)/sec. or 1.5m/min.

The LithostarPlus system is an ecologically sound system designed to make minimal environmental impact. Using only two water-based chemistries (L5000b developer and L5300b finisher) to complete plate processing, the processors replenish chemistries based on real square metre throughput. Chemistry trays are covered to minimise oxidation and a cascade system ensures minimum finisher consumption. Because no filtration is used, there is no solid waste to dispose off. The LithostarPlus system is a so-called 'zero-discharge' system. All used chemistry, including rinse water, is collected in one cubitainer for easy disposal by specialised companies. All silver can therefore be fully recycled.

As a way to ensure consistent quality and operation of the systems, Agfa also offers a remote maintenance service to all LithostarPlus system owners. Using a modem link between the Agfa service centre and the customers's processor, service technicians are able to diagnose small problems very quickly and can help on-site maintenance personnel through a lot of small repairs. For problems that require an on-site visit, service technicians know the extent and the nature of the problem, and the spare parts they need. Problems can be solved in one single visit with a minimum of downtime and workflow disruption.

LithostarPlus LAP-R Applications

The market segments that show the most important penetration of computer-to-(metal)plate technology today are newspaper printing companies on one hand (they require specific plate sizes and a very high troughput but only limited addressabilities) and 8-up printers of books, printing manuals etc. on the other hand (black/white and some spot-colour printing). What we see today is that more and more commercial printers start using computer-to-plate technology (4-colour printing). However, there is also a very strong growing demand for both smaller sized plate (2-up and especially 4-up) and larger sized plate (>8-up) setters.

The demand for smaller size (2-up and 4-up) computer-to-plate is partly filled in by polyester plates (e.g. Agfa Setprint-HN) that can be exposed in regular imagesetters, even for process colour work. The advantage of this is that the customer keeps a 100% flexilbility to go from plates to film and vice versa on the same setter at any time. It only takes him a limited investment (a plate processor). However, polyester plates do not constitute a complete answer to all present 2-up and 4-up computer-to-plate needs. Especially when run lengths over 20,000 impressions are necessary and/or screen rulings over 150lpi, we need a metal plate. Now, this market segment of smaller printing shops is very sensitive to investment costs and therefore wants a metal platesetter at an affordable price.

It is here that red laser diode based platesetters and red-sensitive plates come into play. Red laser diodes are proven technology today for the use in imagesetters/ filmrecorders. They are inexpensive (typically about 100 times cheaper than a 100mW frequency-doubled Nd-YAG laser) and have a very long life time (typically about 10 times longer). Also the electronics for modulation and control of these laser diodes are inexpensive. This technology allows to offer a very reliable metal platesetter to this market segment for a very affordable price (even in a fully automated version). One example is the Gerber Predator, which is equipped with a 670nm laser diode. The list price for this 4-up platesetter starts from 95,000 USD.

A fully automated version (plate input and output) is expected to be available later on this year. Another example is the Versitec platesetter for the newspaper market that is distributed by Polychrome. We suspect that other platesetter maufacturers will follow soon with similar platesetting systems. We are also witnessing the market introduction of several red-sensitive plates. Besides Agfa LithostarPlus LAP-R there is also a red sensitive plate from Polychrome (part of the CTX family of plates (so-called 'hybrid' plate technology)) and a red sensitive silver halide DTR based plate from Mitsubishi Paper Mills.

The combination Gerber Predator/LithostarPlus LAP-R offers a solution to the industry that can cover most of the needs of the 4-up market (affordable price, 200lpi screen rendering, 250,000+ impressions run length capability). At this moment we have 10 customers working with LithostarPlus on a Gerber Predator. Their comments with regard to this new system are very positive and we expect that this number of customers will grow strongly in the coming months.

Acknowledgements

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References

1. P.Coppens, L.Vervloet, L.Leenders en R.Schuerwegen, "Lithographic Aluminum Offset Printing Plate made according to the DTR Process", EP 5,068,165 (July 16, 1990).
2. H.Remmerie, "Lithostar : A Growth Path from Analog to Digital Platemaking", IS&T's Third Technical Symposium on Prepress, Proofing and Printing (1993).