FLAAR Reports

February 2009

Learning about UV-Lamps & UV-Curing

For Understanding Flatbed Inkjet Printers

Nicholas Hellmuth

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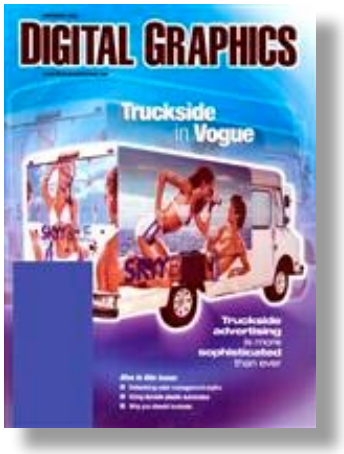
Introduction

FLAAR intends to become a one-stop source of information, documentation, and help to learn about UV-cured inkjet printers, especially wide-format flatbed UV-curing printers. We already offer discussions of the printheads used to jet UV-curable ink. Now we offer our first version of a new FLAAR Report on the UV-lamps and UV-curing processes.

An article by Nicholas Hellmuth on UV lamps has been published in an issue of Digital Graphics Magazine two years ago (Dec 2006 or January 2007). The present FLAAR Reports has several updates because in 2009 LED curing is moving ahead more rapidly. Plus cationic ink actually functions out in the real world (I have inspected cationic ink printers in an active printshop in Chicago, have spoken with other users about how it works in their printshops around the US, and have been with the head ink chemist and done hour after hour of testing in their demo rooms).



So clearly UV lamp technology is rapidly advancing. In past years information was not widely available. But at last trickles of information are available to allow articles such as these by FLAAR to be researched and written. Prior to November 2005, most comments on UV lamps were out-of-date or buried in hard to acquire scientific journals. The IMI conferences, November 2005, are what provided the dramatic breakthrough: a veritable trove of fresh information. But now we are many years beyond that.

Today, in 2009, UV lamp technology continues to improve. LED lamps are used now by four different UV printer manufacturing companies, and Gerber is attempting to employ a curing lamp no hotter than New York in the summer: this “germicidal curing” type UV lamp heats only to about 40 degrees C, and is as long as the material is wide. But, as with any new technology, the first attempts don’t always work. It took Gerber over ten months of trial and error from SGIA ’07 through DRUPA ’08: by SGIA ’08 they had it working (and this is after four years of R&D before that).

The first jet planes, the Comet, in England, crashed one after another. Today everyone in the world flies on their successor technologies. It is the same way with UV lamps.

Curing ink with UV lamps

UV-curing lamps have been used for curing liquid laminate and for curing screen printing inks for many years before UV-curing technology was applied to inkjet inks. But FLAAR is dedicated primarily to inkjet (and to digital cameras, scanners, and is interested in variable-data digital presses). We do not go backwards in time to screen printing at all.

But companies that own screen printing equipment are statistically the most likely people to be interested in learning about flatbed UV-cured wide-format inkjet printers. Sign printing shops in general, those using cut-vinyl or solvent-based wide-format printers are the other major market segment that are early adapters of UV-cured wide-format printers.

UV-curing lamp

UV ink requires UV light to cure itself (to change from liquid to solid form). The UV lights used in 99% of the inkjet printers today are so hot they are melting the materials people wish to print on. Some inkjet printers experience so much heat that the printer structure itself becomes overheated and then radiates this heat even when the lamps themselves have been turned off.

The presentation reviews all traditional forms of UV lamps for curing inkjet inks, and describes the positive and negative features of each lamp chemistry and technology. The focus is to understand the benefits of LED lights for UV curing and how these differ from the more common form of UV curing lamps, Mercury Arc.

How many kinds of UV Lamps could be used in Wide Format Inkjet Printers?

Flash UV lamp technology, correctly designated as Xenon discharge or pulse Xenon, was tried in the entry-level Oce Arizona 60UV printer. This was a brave concept but the model 60UV suffered from poor color gamut and dull matte colors. I have seen occasional references to VUTEk trying flash UV technology in their prototypes, but abandoning this technology quickly.

LED array technology is currently used either as a pinning light (Inca Spyder 150) or as a final curing light (also in the Spyder 150; it has two sets of UV lights). Raster Printers tried LED curing for about a year but abandoned LEDs and returned to traditional hot lamps. Currently Sun LLC (in Russia, no relation to Sun Chemical ink company), Roland, Summit (in the US), and Mimaki (source unknown) are among the few companies that have a fully-functioning LED curing system in a production printer. All other LED lamp curing systems are experimental. The curing system employed by Luscher did not work adequately. So even a major Swiss company was unable to get curing to work several years ago. But now is 2009 and things have improved elsewhere.

Sun FastJet factory visit in the UK, looking through glass, that actually shows the curing area which includes the nitrogen blanket area.

Microwave UV lamp technology is presently used only in the NUR Expedio. These lamps can be only a maximum of 10 inches long.

Other UV lamps can be as long as several feet (2.5 meters) (Maitland 2005).

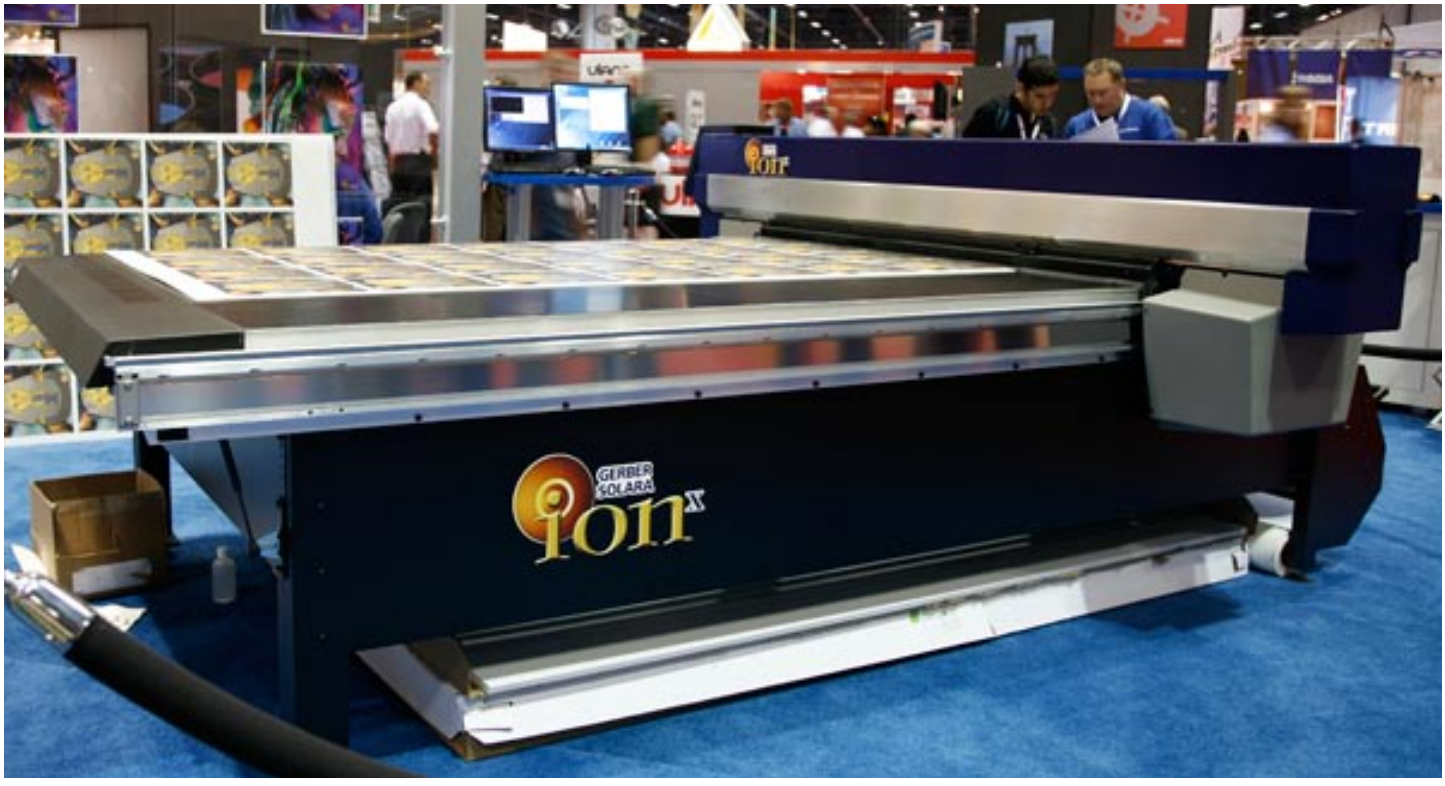
Mercury arc UV lamps are currently the most common UV technology utilized. They are simply known as “continuous UV lamps.” These are the UV lamps used in over 90% of the wide format inkjet printers today.

Excimer light sources are a technology I know the least about. I mention these only because Heraeus is listed as a reference in a paper by Maitland (2005). Heraeus Amba is cited as a source of the lamps for the Oce Arizona T220UV. So my natural curiosity is to inquire whether the Oce T220UV printer used excimer technology? It's a mute point because this printer has been withdrawn, but for the historical record it would be worth citing one way or another.

Technical papers at IMI conferences also list fluorescent tubes, lasers, and electron beam lamp technology, but none of these are yet used in any wide-format UV-curable inkjet printer in production today.

UV-curing in multi-million dollar printers such as the Agfa M Press or the Sun FastJet are in another, higher level of technology and chemistry. They need to use a nitrogen blanket and associated technologies.

Gerber is experimenting with UV lamps that reach only about 40 degrees C (about the temperature of Greece in August, as I experienced at the Athens 2004 Summer Olympics). Elsewhere lamps such as those used by Gerber are reported used as germicidal lamps, to purify water. So far this curing system suffers from the slowest printing rate of almost any printer other than their own Gerber Solara. There are also issues with the surface appearance (at least there were for prints at SGIA '07). During 2007 and most of 2008 no one in the industry (other than Gerber PR releases) was convinced the new UV lamp system or the cationic ink will work adequately. But even now that the Gerber ion prints acceptably in a lab environment, there is not yet enough evidence that either the ink or the curing system will allow printing other than unexpectedly slowly. Keep in mind that the lamps on this system are not traveling with the printheads: the lamps are fixed (unmoving) across the gantry.



Gerber Solara ion^x, at SGIA 07

Another possible future solution: Glass Fiber UV Lamps

Because my background is not in UV-curing lamps, it is a challenge for me to judge the situation when a person suggests that I look at “glass fiber UV lamps.” I mention this, nevertheless, to show that there is a lot of technology available for UV-printing. UV printers – including the water-based kind - are only about 10 years old, and UV printer technology is only half of that. Today, with millions of dollars available for research, and with successful research to be rewarded with substantial printer sales records, there is incentive for considering even technologies that “don’t work.”

FastJet curing area with the nitrogen blanket, at Sun FastJet Factory.

Safety Considerations

Never touch a UV lamp when it is illuminated. The outside temperature is about 800 degrees Celsius. Inside it is the heat of plasma.

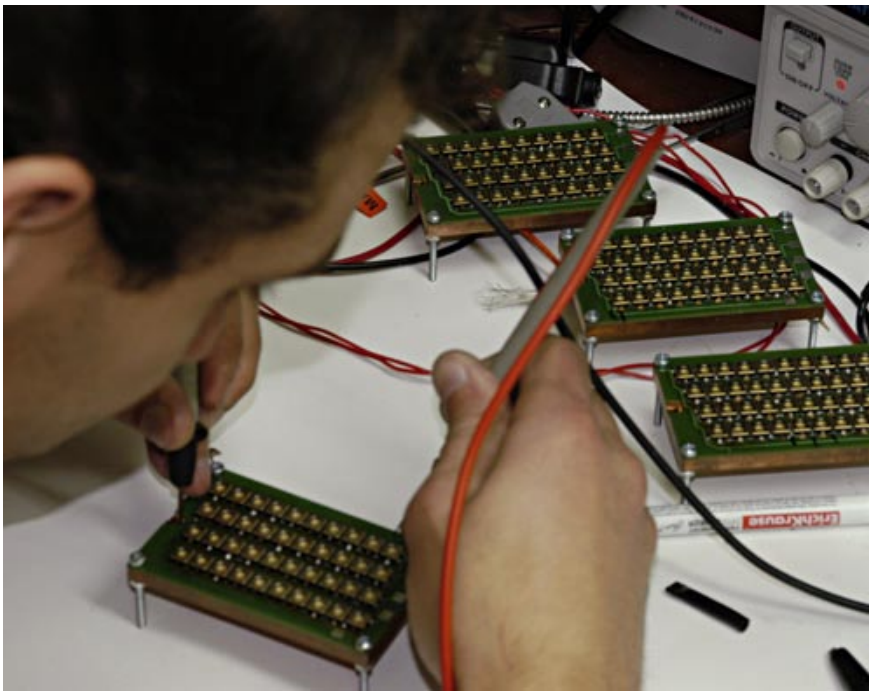
Further Information on UV Lights for Inkjet Printers

Additional Comments on LED Lights for UV-Curing

Only a little more than one year ago, most industry gurus stated that cationic curing chemistry was unlikely and that LED lights could not adequately work with inkjet printers.

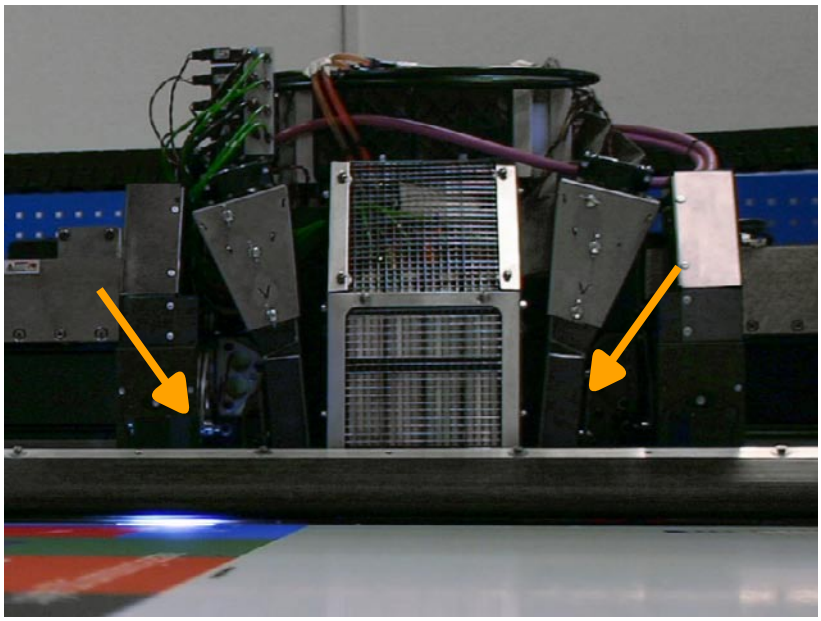
Yet LED lights are already at work, successfully, in the Inca Spyder 150. And Durst introduced the first UV printer using cationic ink chemistry in November 2005 (at Visual Communications, the Milan sign trade show). So everything related to UV chemistry is changing now that manufacturers realize there is millions of dollars in profit available.

But as a reality check: the cationic ink from Sericol, reportedly used in the first Zund 250 printer (of which perhaps 5 machines were installed during 2004-2005), evidently failed to function appropriately. It took two years to retrofit the Zund 250, which has now been re-released, but most likely with no more attempt to use cationic UV chemistry. FLAAR covers the inherent problems with cationic ink in a separate FLAAR Report, on UV-cured inks.



Testing LEDs light at Sun LLC at factory visit 07

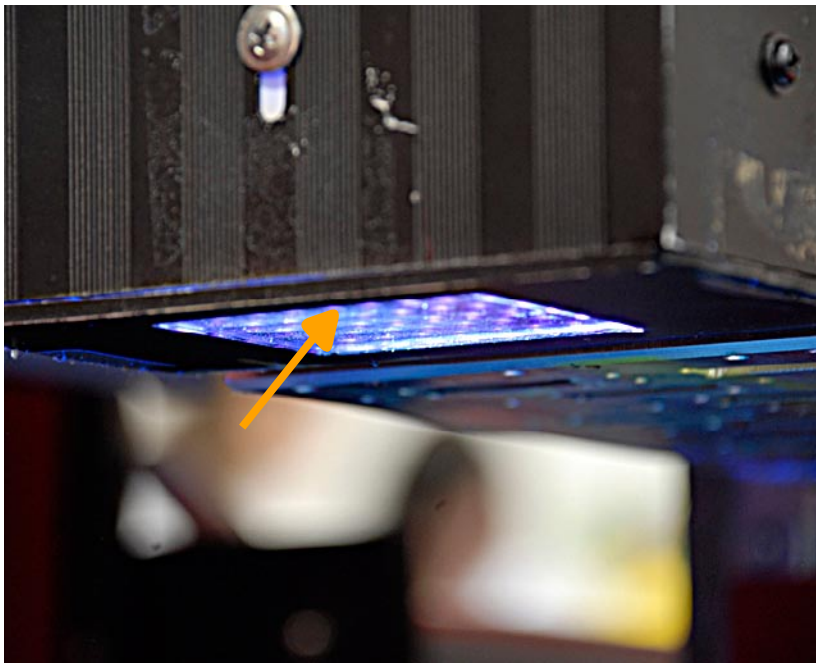
Then, in 2007, Raster Printers began experimenting using LED lights. Over the next six months they learned to what degree they work (in pinning) and to what degree not. The same printer has one traditional mercury arc UV lamp to do the actual curing. By having two lamps you can, in theory, use the LED lamps while printing (with the heads close to the substrate to get the best quality). At this phase the advantage is that the LED lamps pin the ink (fix it slightly). But a few months later Raster Printers decided not to continue with LED curing. Today their printers use traditional mercury arc UV curing lamps.



Inca Spider 150 UV LED lamps, at Factory visit in 2007

Then, if the material is heat sensitive, you can do the cure afterwards (with the mercury arc lamp); you don't need to have the carriage close to the material because at this stage you are no longer printing.

You may say, "well this takes twice as long." But, if this mode allows you to print on specialized materials that are very thin, then the lack of production speed is less an issue. More and more I see companies large and small that come to FLAAR to ask our help as consultants. They want to learn which UV printer to buy for proofing. Not for production. So speed is simply not a priority; or at least the cool-cure of LED is more important than a faster speed.



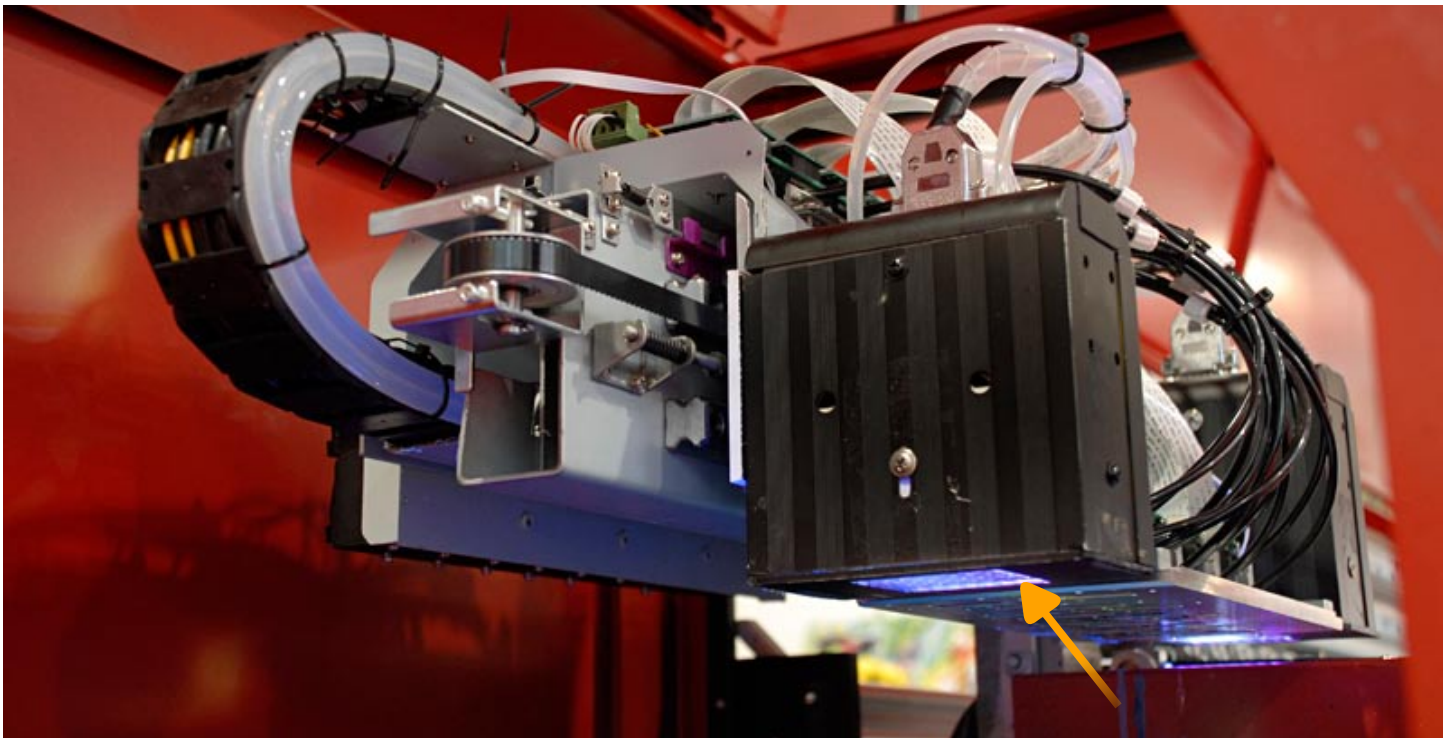
Sun LLC LED lamps at FESPA 07

Most UV printers are designed for signs, banners, POP, etc: traditional signage. But the even larger markets will be for niche applications, such as proofing. Mimaki has learned this early on, so their series 605 UV printers are not for mass production of signage (or at least not bill-board size).

LED lamps have several immediate advantages:

- Substantially less heat emission (so you don't damage the substrates being printed on)
- You can turn them off and on as often as you wish (so you don't need shutters)
- LED lamps last multiple times longer than conventional UV lamps used presently.
- Less generation of ozone (Walshe 2005)

Naturally, everything in life has downsides. LED lamps are weak; you need clusters or arrays of them to obtain the UV curing that you need. Then you may need a nitrogen blanket to reduce oxygen inhibition (inhibition of photoinitiators caused by the presence of oxygen).



Close up of Sun LLC printhead carriage. Arrow pointing at the LED lamps

Dr Nicholas Hellmuth examines the Sun Neo UV LED printers, at FESPA 07

Sun Neo UV-LED Evolution at FESPA Digital 08

The Inca Spyder 150 was able to achieve a greater range of surface texture from matte to glossy, and consequent increase in color saturation, by means of varying the cure with LED lamps (Campbell 2005).

We are aware of at least one major manufacturer of industrial-strength UV-flatbed printers (in addition to Inca) that is seriously experimenting with LED lamps. So it would be fair to assume that others are checking out LED lamps too. So over the next several years look for more LED lamps in use. By DRUPA 2008 you could see a number of such evolved UV lamp technologies, as well as more use of cationic UV ink chemistries.

Sun LLC in Novosibirsk, Russia, is a leader in developing both UV-curable ink that can be cured by LEDs, and for doing the electronics for the LED curing aspect. FLAAR has spent many days in their facilities, both in their R&D and in their impressive ink factory. Since there are several FLAAR Reports on these visits, there is no need to repeat all this information here.

Summit had an exhibit at one trade show last year (SGIA '07) but they no longer have their key UV-printer person, and he was the main spokesperson for their program. So I am unsure how far this company will get on their own without a key inkjet person in an executive management position.

There are three issues at play here:

- technology,
- personality and connections of the owners of the technology
- and cost of the finished product.

This is why consulting business at FLAAR is improving, since an LED company may be great at technology but is missing the second half of the second factor.

Inca Spider 150 UV at FESPA 07. This printer uses the LED lamp technology for the process of curing the ink into the media.

Nichia in Japan is a primary supplier of LEDs for UV-curing systems. Their web site is www.nichia.com.

The LED system exhibited by Dilli at SGIA '08 used Sun ink, 395, 2 watts per sq cm; next version will have 4 watts per sq cm.

Shutters

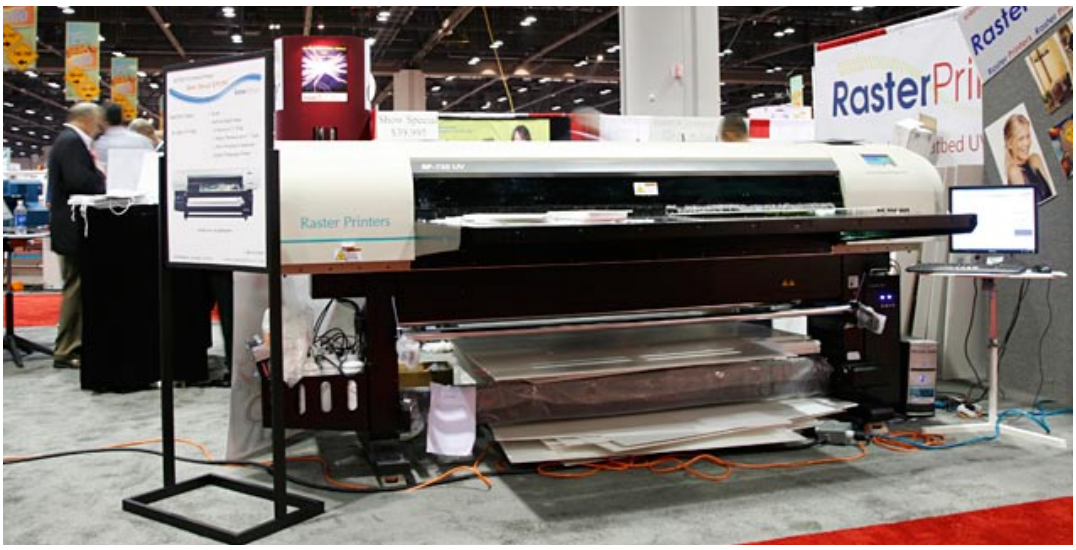
Shutters on the lamps are used except for a few of the cheaper printers. Shutters close off the light and thereby minimize heat, though even a shuttered lamp is still producing heat immediately behind the shutters. Shutters (or the mechanism to move them instantaneously to block the lamp for seconds and then unblock it seconds later) are expensive. So only the more sophisticated printers have shutters.

Here the advantage is with LED lights: they can be turned completely off and on without causing premature failure.

With a mercury arc lamp you lesson the life of the lamp by about an hour every time you turn it off an on.

Masks

The Raster Printers RP-720UV has no shutters (in order to keep the cost of the printer down). But the RP does have three different sizes of masks. But this is just one more thing that you have to do by hand, lowering productivity. You not only have to put them on by hand, you then have to take them off if the next material does not want that particular masking ratio.



Raster Printers RP-720 UV printer at SGIA 07

Reflectors

The shape and position of the reflector is another issue. The reflector is the mirror-like surface that aims the light back down onto the material. The arrangement of the lamp (bulb) and reflector is comparable to the arrangement of a reflector in a professional photography studio tungsten lamp system. But in the UV situation there are other factors, such as what wave-lengths do you wish to reflect.

Michel Caza, a pioneer in UV-curing for screen printing, observes:

I do not like dichroic in both technologies, or it must remain "movable" because, at the exception of CYMK, LC, LM or even green and orange (limit) all the other colors need a "cocktail of radiation" to cure properly a lot of spot colors and of course the white and opaque black (from 220 to 5,000 Nm). Dichroic mirrors disperse the infrareds that we also need. Dichroic where used - sometimes only - in screen since 85 (Svecia started) and in digital some companies started to use this technology in 2003 only.

A new technology is the blue mirror heat-reducing IR reflectors. They absorb part of the spectrum and reflect the wave-lengths that the ink needs to be cured. So far I know of only two printers that use heat-reducing systems: DuPont has the blue mirror technology. Durst has not yet listed what technology they use. Once the word gets out, most manufacturers will switch to blue mirror technology or at least check it out.

Blue mirror technology is German, and I first read about it in detail in the German magazine SIP. There is not yet much information available on the Internet, especially not in English, so it helps to be able to read Deutsch.

Knowing when you need to Replace your Reflectors

I have not yet found any industry study of lamp reflectors per se. But just like in a photographic studio tungsten lamp system, most of the lighting is reflected from reflectors. Due to the intensity of the UV lamp, these reflectors get "dirty." If much of this soiling is also from misted ink, then your printer has a problem with misting. Misting is especially prevalent in solvent ink printers. Misting occurs because the ink is turned into mist-sized droplets to jet out the nozzles. The printhead carriage is moving at a high speed; there is airflow generated by the movement of a large object (the entire carriage) through what is effectively a tunnel. Misting results: stray ink clouds up, like mist on a misty night or morning.

If the mist is affected by heat it gels; if the mist is affected by stray UV light it solidifies.

Increasing the Useful Life of your UV Lamps

Do not touch any UV lamp with your fingers. Finger oil will cause premature failure of the lamp. The imprint of your finger, in oil, causes the same kinds of problems to UV lamps as fingerprints do to tungsten lamps used in professional photography studios.

Knowing when your Lamps need Replacement

If you have a quarter-million dollar printer, it should have some means to keep track of the hours your lamp has been on. But then you also have to keep track of how many times your lamp has been struck (turned on).

There are ways to measure the output of your lamp, but they are awkward, time consuming, expensive, and at the end, not very convincing.

Cost Factors

As a print shop owner, it may be useful to know the cost aspects so you can factor these into your ROI projections. You will need to learn the answers to these two important questions:

- What is the cost of each lamp to replace?
- How long will each lamp last?
- How often should you replace the reflectors?

You need to be aware that every time you turn the lamps on, this counts as one "strike." Each strike may cause the lamps to age by the equivalent of 1 to 4 hours of actual use. On top of this, you then have to realize that you need to replace both lamps at the same time; so if one lamp costs $450, you have a cost of $900 to replace both lamps.

Although with most printers you can change the lamps within 5 minutes, some lamp changes are a serious time consuming chore. So far, the only printer that has a seriously complex path to get deep into the printer's innards is with the Oce Arizona T220UV. This is a heavy duty printer; - very solid - but not designed for speed (neither printing speed nor lamp replacement speed!).

To become better prepared in how to manage your UV lamps, we recommend an article by Ben Rosenfield, "Caring for your Inkjet's UV-Curing System." You can download it from the Internet with a simple search on www.Google.com.

If your UV lamps last 2000 hours, replacing them is obviously half the cost as if they last 1000 hours. The owner of a Mimaki JF-1610 UV flatbed printer said: “UV Lamp – we only run one lamp at a time and we run the machine every day for 8-10 hours a day. We had a lamp fail at exactly 500 hours which is what it is warranted for so we had to buy a new one. You know how expensive those lamps are. Is this what we should expect? To spend that kind of money maybe every 10 weeks? Are the lamps designed to fail so fast? Can we get Mimaki to improve on this?”

Heat Issues

The heat is a safety concern for tender human skin as well as an issue for damage to heat-sensitive materials that you are trying to print on. More than 50% of what the UV lamp produces is simply heat (IMI Conferences, www.imiconf.com). So the cooler LED lamp technology has a n immediate advantage.

Cooling

Lamps can be air-cooled or water-cooled. Air cooling has the disadvantage that the air can blow the jetting ink off course, resulting in poor image quality. Water cooling is expensive. Most lamps simply have one or more fans at the top. The Durst Rho 350R has what looks like exhaust hoses rising up from the lamp areas. This printer is so new I don’t yet know what these hoses are exhausting.

Raster Printers uses two quartz sheets in front of their UV lamps and pushes air between them to cool them to the extent possible.

L&P Virtu (now WP Digital AG) has sophisticated cooling system, as you would expect on a high-end UV printer.

Water-cooling carriage for the UV lamps, at Spuhl factory 08

UV lamp cooling, at Spuhl factory 08

Pertinent Quotes

Burned out bulbs and the heat related issues around Mercury arc really are a problem.

This is the quote of an owner of a Durst Rho 160 in 2007. But realize that this printer was designed in 1999 and first released out of beta probably in 2001 or 2002. All Rho printers are significantly improved today.

Doing the UV Curing in Two Steps

As inkjet printer manufacturers learn more about UV-curing chemistry, and as lamp manufacturers learn more about the needs and expectations of inkjet printer users, changes and improvements are happening. For example, either LED or pulse Xenon UV lamps are being used to pin (partially solidify) the ink drops. This stops dot gain (Yandall 2005). You then use a normal UV lamp to totally cure the ink further long in the system. The Inca Spyder 150 was the first wide format inkjet flatbed that did curing in two stages. What was even more unique is that both stages used LED form of UV lamps. The Luscher printer is also curing in two stages.

Inca Spider 150 UV printer

Pinning with an LED lamp might make it easier to use 1/16th inch Styrene. With regular lamps Styrene this thin will bubble up. This ruins the sign material and can scrape against the nozzle plate of the printhead.

Pinning

Pinning means to pin the wet ink with a light fast cure, with just enough UV light to turn the liquid ink into a non-liquid (so it won't run on the surface or wick into the material." The idea is to avoid over-heating the material. You then cure the material later, either in the same machine or in an adjacent one. Once the ink is pinned, the curing lamp can be higher and thus will not incinerate the material you are printing on.

Issues with UV Curing Lamps

So In several cases the UV lamps were a major factor in a printer not functioning well:

- An early Vutek (tried to use Xenon lamp technology. The early model had countless other issues, since at this time not enough people had familiarity with UV-curing technology.

• The pre-Zund printer sold by Perfecta had the UV lamps too close to the printheads. The Xaar heads could not take the heat and there were head failures constantly. The heads were moved an inch from the printheads, ventilation was improved, and heads began to last longer.

• The Oce Arizona 40uv had so many issues it's hard to pinpoint which caused its demise, but an imperfect UV lamp system was one contributing factor.

• The $650,000 Luscher JetPrint has issues with its UV lamps. At least some of these UV lamps were made by Phoseon. The Luscher had so many problems (more than just the curing, though that was most of it), that Luscher had to shut down its attempt to be a manufacturer of UV-curable inkjet printers.

• The nice Inca Spyder 150 tried to use LED lamps in 2004, before this lamp technology had advanced as far as it is today in 2007. Fewer than 30 of this model of printer have been sold in four years.

Printing Defects (unsightly linear patterns)

If you jet the ink only while the printhead is traveling in one direction (say, left to right), this will have fewer appearance defects than if you jet ink while the printhead carriage is traveling in the opposing direction (say right to left).

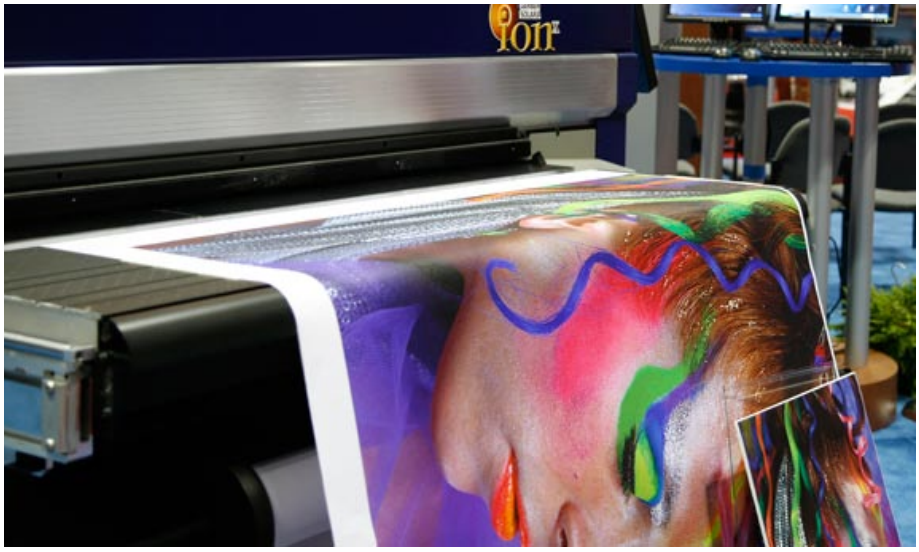
This unsightly pattern is called the "lawnmower effect" and is clearly visible as if a lawnmower went first one direction and then the second direction (throwing the cut grass in a clearly different angle depending on the direction of movement of the lawnmower).

It's the same with UV ink, since the ink droplets hit the material all in the same direction when the printheads are moving from left to right. Then when the printheads move from right to left, the droplets fall in the opposite angle. The light reflects off the dried ink at a different angle. This appears as banded patterns, and is considered unsightly.

To avoid lawnmower effect you either have to print in uni-directional mode, or use sophisticated software to overcome the laydown pattern, or use lamination to change the surface appearance.

Other Printing Defects

At SGIA '07 Gerber was trying to print with what some industry consultants described as a germicidal UV lamp. This kind of lamp was needed in order to keep the temperature down to 40 degrees C. But the surface characteristics of the print samples were most politely described as splotchy, and in a manner no one has ever seen or described before. Seemingly this is an unintended result of experimenting with an atypical UV lamp and an unfinished cationic ink.



Gerber Solara ion^x, at SGIA 07

Some UV-curing Lamps do not (yet) achieve Full Cure

The first prototypes of the Mimaki roll-to-roll hybrid with LED lamps at DRUPA 2008 and Shanghai 2008 (early July) had noticeably incomplete curing. The resulting prints were tacky to the touch. But once the ink was improved (by the time of FESPA Mexico, late August 2008), the tackiness was decreased noticeably (though perhaps still not as full a cure as some more intense mercury arc curing systems).

The Roland UV printer is too new and until it appears at ISA 2009 it will not be possible to test it for how well it's LED lamps can cure its ink. Roland covers its ink with a clearcoat, so there is no way to easily examine the ink to see how tacky or "uncured" the Roland ink is.

A more bizarre example of lack of complete curing is from the "germicidal" kind of long, relatively cool UV lamp used by Gerber. It is the length of a fluorescent lamp and is comparable to the kind of UV lamps used to cure waste water and other things of that nature. Naturally Gerber does not make any information available at all and seals that part of the printer so thoroughly with a skirt that no one else can see what's inside.

Mimaki roll-to-roll UV LED printer at DRUPA 08

Gerber said they don't want anyone else to copy their advances. KonicaMinolta, who provides the cationic UV ink to Gerber, does not use such a germicidal-like UV lamp. KonicaMinolta, who has more experience in all of this, is experimenting with an LED lamp. You could see this in the KM printhead booth at DRUPA.

The issue with the Gerber cool curing is whether this can fully cure the UV ink on paper or any porous substrate before the ink has time to sink into the paper (and effectively disappear from the surface to some degree).

The second aspect is whether the long germicidal-type (non-mercury arc lamp) allows the ink not only to go down into porous material during printing, but allows the ink that remains uncured to migrate further down, causing the ink to become even less saturated after several days.

And why does no trade magaine or PR agency mention any of these issues?

Incomplete curing affects odor of the ink in many instances

Some UV ink has a bad smell anyway; one ink brand in particular is getting this reputation, but I wish to check at the next trade show to confirm this.

But one reason that any UV ink can smell badly, and remain emitting unpleasant odor for days and sometimes weeks, is if you try to achieve a gloss finish. On some printers you achieve a gloss finish by lowering the curing. So you end up with a nice satin finish, but the ink is, in effect, not cured for days, or weeks, or in worse case scenario, for a month or two. This comment is based on test printing FLAAR undertood three years ago.

Incomplete curing is sometimes hidden by clear coating

Roland is putting clear coating over all their prints so you can't see whether the ink is really cured or not. Reports indicate that you can still smell the photo initiators and that the edges show problems. In other words, the nature of the chemical reaction under the clear coating is not well defined and is obviously not often discussed, certainly not in the spec sheet! What I would ask is, what is the long-term effect of potentially unsured ink inside under a top coating? How does this affect the edges? Especially if you later trim the piece.

Process of printing. The UV light is curing the ink.

How Curing Affects Speed of Printing

If the printhead carriage moves too fast then the ink does not get cured fully. So slowness of the printers is not always only a result of slow mechanics, Slowness may be necessary in order to cure the ink.

Cure also depends on which colors are on top of which other colors, and how thick the ink layers are. Cure may be different on colors that absorb UV light, such as yellow and black. So there are a lot of factors at play.

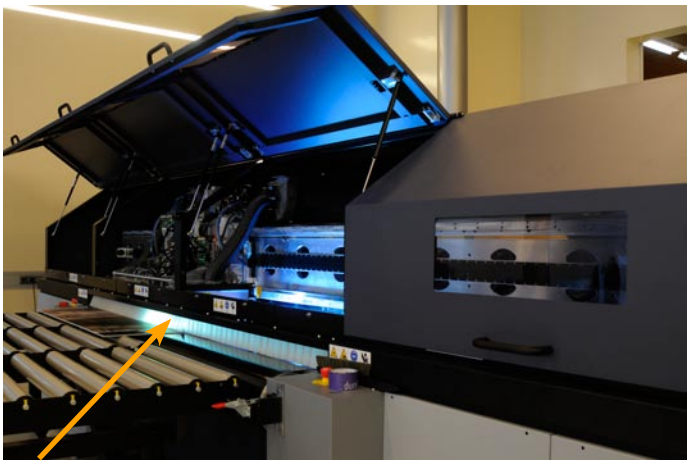
Which Lamps are used in which Printers

Manufacturers occasionally change from one lamp brand to another. So this list is our best knowledge at one point in time.

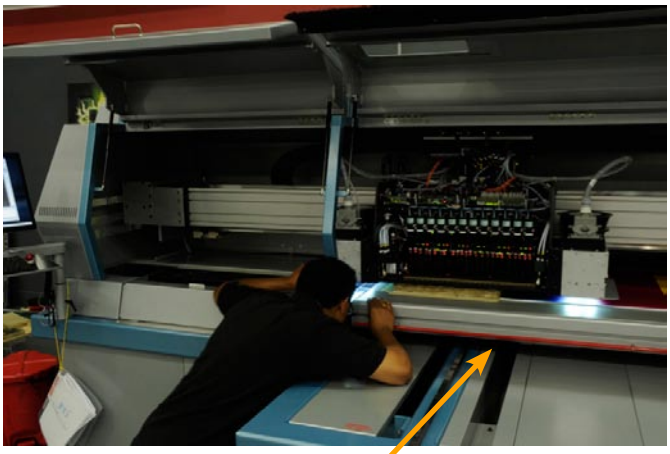
UV lamps from Dr. Hönle are used by

- Durst Rho
- Gandinnovations, both flatbed and roll-to-roll
- Scitex Vision VEEjet (we assume the + model has the same).
- Matan Barak roll to roll
- One Teckwin flatbed (but Chinese printers change components often).

UV lamps from Dr. Hönle at FESPA Digital 2008

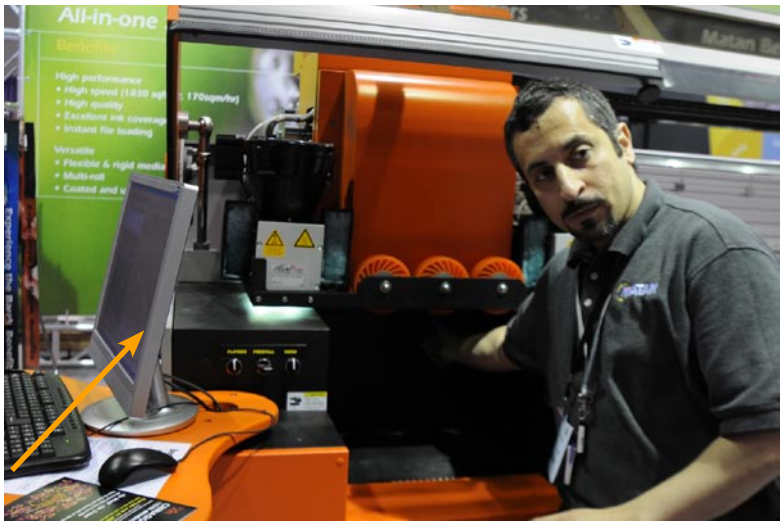


UV Lamp Durst Rho Lienz Site Visit



UV Lamp Gandinnovations 1224 UV Factory Visit 08

UV Lamp Scitex Vision VEEjet at SGIA 2003



UV Lamp Matan Barak at ISA 2008

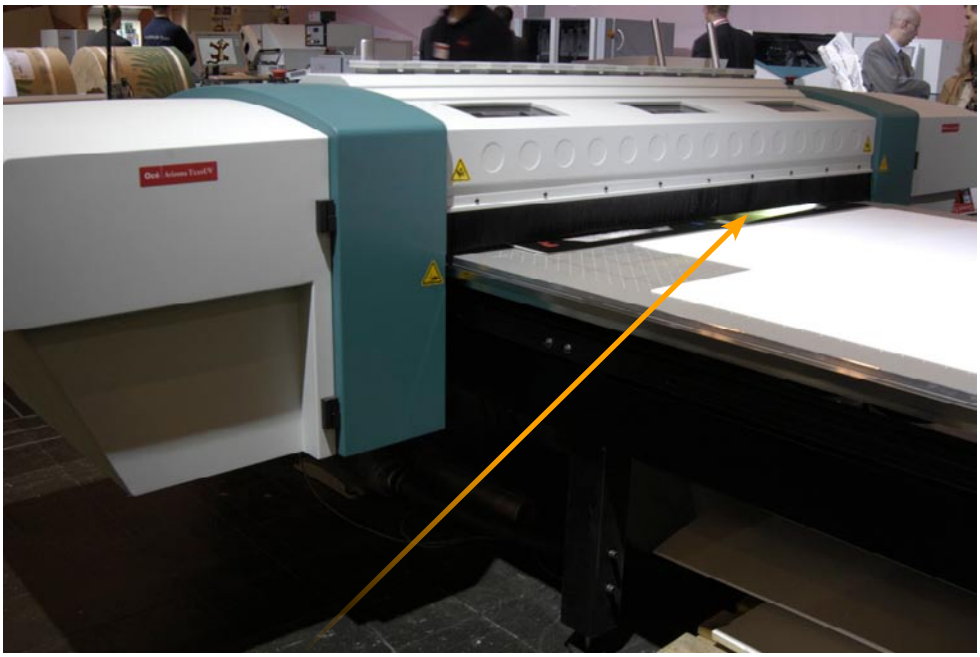
Fusion UV (microwave)

- NUR Expedio (one of the few with microwave UV technology that I am aware of)
- ISI retrofitting for NUR Blueboard uses microwave UV technology too. The brand Is not stated but Fusion would be an educated guess.
- DJT 400, a printer that failed to appear despite considerable PR and advertising.

Heraeus

- The Oce Arizona T220 UV, used a customized version of a Heraeus lamp. This printer model is no longer manufactured by Oce.
- Heraeus managers claim their lamps are used in other brands but declined to say which.

UV Lamp NUR Expedio

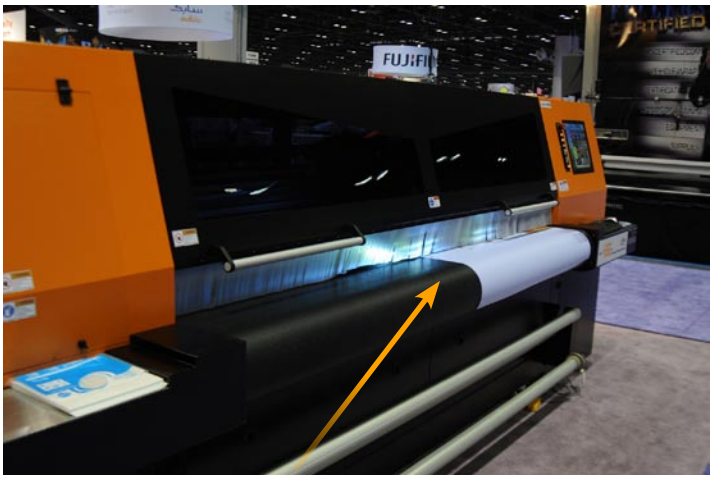


UV Lamp Oce Arizona at DRUPA 2004

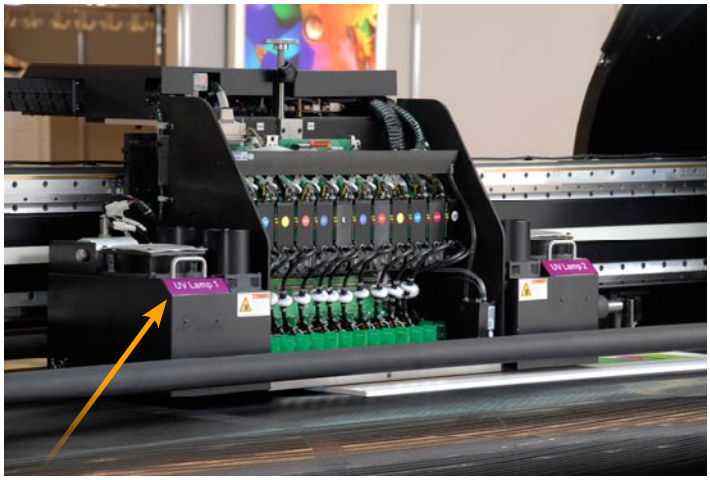
Integration Technology

- ColorSpan 72UVR and UVX
- D.G.I. – Dilli
- DYSS
- DuPont Chroma Print 22(US version of a large Flora 2200-series flatbed)
- Gerber Solara
- Inca Spyder 320
- Infiniti UV1612S
- IP-I (founded by people from the breakup of Hypernics)
- Luescher[1]
- Neoltjet
- NUR Tempo
- Oce Arizona 250 GT
- Zünd 215
- Zünd 250
- Yishan (sold by Digirex, in Turkey)
- And several other Chinese printers

UV Lamp ColorSpan 72 UVX at SGIA 2004



UV Lamp DYSS at ISA 2008

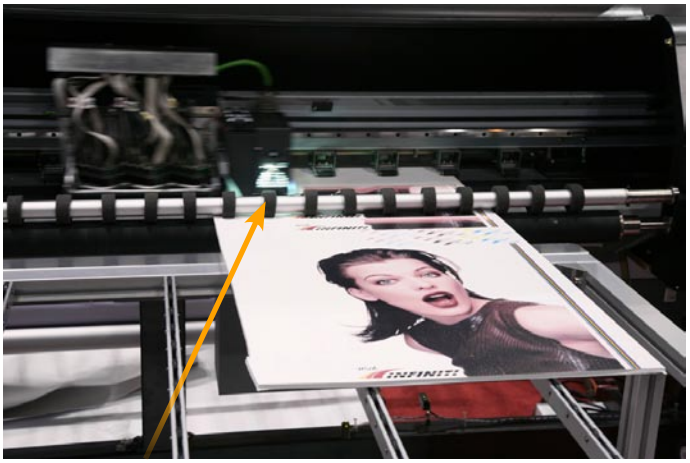


UV Lamp DuPont Chroma Print 22 FESPA 2007

[1]Luscher has had issues with their lamps and curing system since the beginning. They have thus had to revise their lamp and curing system since these notes were taken.

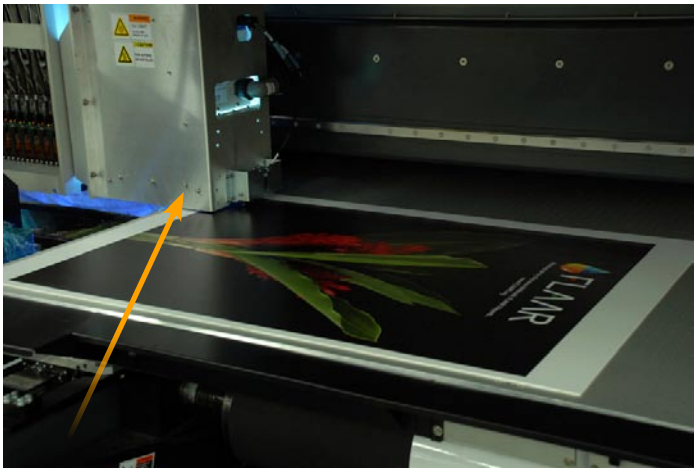
UV Lamp Gerber Solara UV2 at SGIA 07

UV Lamp Inca Spyder 320 UV Factory Visit 07

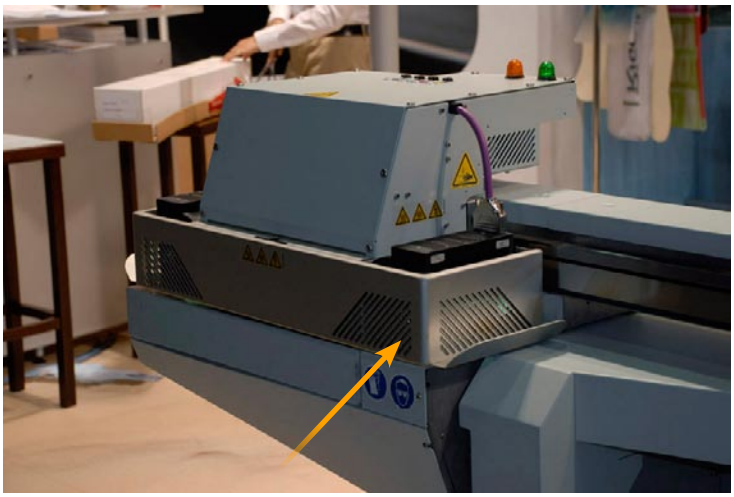


UV Lamp Infiniti UV1612S at ISA 06

UV Lamp IP&I 1606 UV at ISA 07



UV Lamp NUR Tempo Factory Visit 2007



UV Lamp Oce Arizona 250GT at FESPA 2007

UV Lamp ZUND 250 Factory Visit 2007

Nordson

- Agfa :Dotrix
- Inca Columbia (but not all Inca Spyders)

Osram

- Eastech

Phoseon

- Add-on LED system for Luscher JetPrint
- One of the two lamps on a prototype version of the Raster Printers Daytona T600UV is a Phoseon LED (Phoseon RX Firefly system). But the production model T600 no longer uses LED lights.
- Dilli Neo Titan UV 1606 at SGIA '08, for 395 wave length Sun ink.

JELight Company[2]

- Prototype of Raster Printers Daytona T600UV[3]

[2]I have not yet been able to identify any other current model of wide-format UV printer that uses lamps from JELight Company. But since there are several dozen printer manufacturers who decline to mention the source of their lamps, there is a theoretical possibility that one or two other wide-format printers may use their lamps. We do not list narrow-format inkjet label printers, screen printing, nor UV-cured laminators.

[3]The production model of this printer will have lamps from another manufacturer (most likely Integration Technology) because of high heat from the lamps used in the prototype.

Developed in-house to some degree, rather than a total system bought off the shelf

- ColorSpan 5440uv
- Vutek QS3200, QS2000

"Developed in-house" can mean that the printer manufacturer would rather not have competitors know which UV lamps they really use, or generally means that they develop some aspects themselves.

But in almost all cases these printer manufacturers still obtain the basic hardware from Integration Technology or the lamps from Heraeus Amba.

It is worth commenting on the fact that the company with the most success in lamps for inkjet printers is the company that makes lamps primarily for this market, as opposed to older lamp manufacturers that made a wider variety of UV-lamps for many years, but which are not particularly appropriate for today's wide format inkjet printers. For example, microwave UV technology is used by only one printer (the NUR Expedio). So a company that specializes in this older microwave technology is not going to place as many units as is a company that homes in specifically on meeting the needs of wide format inkjet manufacturers.

Nordson seems to make UV lamps primarily for narrow-format industrial applications such as product coding, direct mail (Maitland 2005); these are not wide format inkjet applications. Nordson's US headquarters are in Amherst, Ohio, so at some point we will visit them.

Fusion UV makes primarily microwave-powered UV lamps, so used pretty much only by NUR (HP Scitex).

Chinese UV lamps

One distributor told me "The original printers had Chinese-made UV lamps. But these lamps were not capable of curing the ink." This was as recent as late 2007.

It's amazing that any manufacturer is willing to buy and sell Chinese-made printers with this kind of record still prevalent as late as 2007. Fortunately, by 2008, at least two Chinese manufactures have improved; of these Teckwin has the best in-house quality control that I have seen during a factory inspection.

Other manufacturers of UV Lamps

IST Metz does not yet make UV lamps for wide format inkjet printers; only for other applications.

Phoseon Technology is moving into wide format inkjet printer technology via an alliance with the Spectra printhead company. Phoseon uses semiconductor light matrix technology (SLM), which should be compared with LED lights.

Trend to "make your own" UV lamp systems

UV manufacturers in China, Taiwan, and Korea are occasionally using their own UV lamp systems, in order to cut costs. This is okay if they work, but some Asian printers have been caught using counterfeited parts (not specifically UV lamps; but in general). The printers that are rebranded and sold in the US had to get rid of these counterfeit parts once they realized this was not allowed in the US or Europe.

In the opposite direction, some Chinese manufacturers feel they need to stress that they are using European, American, or Japanese parts in order to try to convince buyers that their entire machine is up to international standards. But it does not help to have a British UV lamp if the nuts, bolts, and screws holding it onto the carriage are made in China. The owner of an Infinity UV printer told me that his UV lamp simply fell off. The owner of another of the same UV printer brand told me that nuts, bolts, and screws simply fell off, broke off, and came unscrewed month by month on a regular basis.

Making your own UV lamp system is more successful with top-tier companies, since they have access to better technology. MacDermid ColorSpan reports that "The mercury arc system that we developed for the 5400uv system cut our cost in 1/2 while greatly improving reliability." In other words, doing it yourself can (in some successful cases), be lower cost and better than off-the-shelf lamps. But in most cases the printer manufacturer simply wants to save money by doing as much on their own as possible.

The ColorSpan printers are made in Minneapolis, not in China.

Grapo makes their own UV lamp system in the Czech Republic.

Phoseon booth at FESPA 07

Not yet identified

Most attendants in a trade show booth do not know the brand of UV lamps that are in their own flatbed printers. In other cases they give only generic answers, that do not actually indicate which brand of lamp is used. In a few cases they politely decline to give any information at all, saying that the brand name is a trade secret.

If a print shop owner is about to spend $250,000 on a printer, they may feel they deserve to be informed of what key components are inside the product they are considering buying. Besides, owners will sooner or later find out what is inside their printer, so hiding documentation is neither helpful nor meaningful. But finding the information can take a few months, so here are the printers that are still "unknowns."

- Aellora, narrow format, not wide format (discountinued)
- Agfa Anapurna / Mutoh Cobra; too early to tell, but probably Integration Technology.
- Agfa :Anapurna XLS (not made by Dilli)
- Agfa Thieme M Press
- Ardeje (not yet shown in the US or outside France; did not survive birth)
- Azero Creon (Hypernics, same as Azon; Hypernics went out of business by 2005)
- Azon (Hypernics; same as Azero Creon)
- DuPont Cromaprint 22uv
- Durst Rho 160
- GCC StellarJet
- Gerber ion (source of their "germicidal lamps" is not yet known).
- GRAPO Octopus
- L&P Virtu
- Mimaki, various models
- Mimaki (source of their LED lights is not known).
- Oce Arizona 60UV
- PIT (non-functioning at FESPA 2005; not shown since; Bulgaria)
- Roland (source of their LED lights is not known).
- Vutek 200/600
- Vutek 320/400

More to come in the Future

Every aspect of UV-curable ink flatbed printers is improving. The inks get better each year. The printers get better each year. But UV lamp technology improves only slowly. Overheating is the most common unresolved aspect of the design and construction of UV-cured wide-format printers today (and is the aspect least talked about).

It has taken a while for UV lamp manufacturers realize that wide format inkjet printers have different requirements than narrow format label printers or screen printers.

Paul Yandell mentions that dichroic filters and mirrors will help make curing systems cooler (2005, IMI conference). Dichroic reflectors are nicely described by Stowe, p. 14.

Substrates improve only gradually. Avery Dennison is able to improve its substrates, but manufactures of other materials are so used to churning out their regular stuff that they don't yet worry about the special needs for UV printers (no warping; no chipped edges; all things that cause head strikes on inkjet printers).

We may see more of two-stage curing, with an immediate pinning by one set of LED lamps and then a fuller cure shortly thereafter with mercury arc UV lamps.

You will see several more LED curing printers at FESPA Digital Europe '09 in May, and/or by SGIA 2009.

Increased need for more information: more than PR releases

Only trickles of information are available on LED lights for UV curing. The easiest article to obtain is by Dr Nick Campbell (2005), available from www.imiconf.com. But that was two years ago, so clearly more studies are needed of LED reality today.

Historical list of wide-format inkjet printers using LED curing

- Inca Spyder 150 (circa DRUPA 2004)
- Sun LLC, circa 2007
- Dilli already experimenting in 2007
- Mimaki hybrid, DRUPA 2008
- Newer improved Evolution NEO LED printer with Sun LLC system, DRUPA 2008
- Roland hybrid, late 2008
- Dilli exhibits their Neo Titan with LED curing at SGIA '08, quietly without labeling it.
- DYSS already experimenting with LED by 2008

I am under NDA on other UV printer manufacturers that have LED-curing under development.

Inca Spyder 150 at DRUPA 04 tradeshow

Bibliography

During early years I used resources on the Internet and kept track via a bibliography. In the past three years I have found it more useful to undertake research directly at the R&D facilities, factories, and headquarters of the principal UV-curable printer manufacturers, so I do not maintain a bibliography of recent works. So do not be surprised that this brief list of references is primarily for the years 2004-2005. 2004 is the year I began full-time study of UV-curable printers after seeing the first UV printer prototypes at DRUPA 2000 and Photokina 2002 and then seeing the fully developed ones at DRUPA 2004.

CAMPBELL, Nick
2005 LEDs for UV Curing -- Past, Present & Future. 13th Annual European Ink Jet Printing Conference, November 2005, Lisbon, www.imi-Europe.com.

KARLICEK, Robert, Jr.
2008 Novel Ultra-High Power LEDs…for UV Curing. Radtech. May 2008.

LOCKWOOD, Adrian
2004 Where are UV Lamp Systems in Inkjet Today? And Where are they going in the Future? IMI, 2nd UV Ink Jet Symposium, Scottsdale, Arizona, Feb. 2-3, 2004.

MARX, Dan
2007 Bright Spots on the Horizon—UV LED and Inkjet Graphics Printing. RADTECH Report November/December 2007, pp. 42-43.

Brief but informative and well-organized article, but lists Sun LLC as the “first” commercial use of LED in wide-format inkjet. No, not really. Inca Digital was first with the Spyder 150, and it is possible that there was LED curing inside the Luscher JetPrint a year or so before the Russian system was shown. What was “first” about the Russian system is it was the first to be displayed openly and clearly as LED. At DRUPA 2004 not many people in the Inca booth were telling many people there was LED curing. Same with Luscher (they tried to keep me from even being able to have access to their User Manual; of course I got it anyway).

SIEGEL, Stephen B.
2004 UV LED Curing Technology as applied to Ink Jet Printing. IMI, 2nd UV Ink Jet Symposium, Scottsdale, Arizona, Feb. 2-3, 2004.

STOWE, R.W.
No date
UV Science for the Non-Scientist, Part I: Demystifying UV Curing. Reprint available from Fusion UV Systems.

STOWE, R.W.
2004 Techniques of Optimizing UV Ink Jet Curing Process. IMI, 2nd UV Ink Jet Symposium, Scottsdale, Arizona, Feb. 2-3, 2004.

YANDELL, Paul
2005 The Ups and Downs of UV Wide Format Printing. IMI 13th Annual European Ink Jet Printing Conference. Lisbon, November 2005.

The complete bibliography for UV-cured inkjet printers is a separate FLAAR publication.

Sources and Resources on the Internet

A www.google.com search for UV lamps inkjet printers will turn up more entries than you will have time to read. But some useful sites suggested at the recent IMI-Europe conference include.

- www.cree.com
- www.ledmuseum.org
- www.ledsmagazine.com
- www.luminus.com
- www.lumiLEDs.com
- www.nichia.com
- www.roithner-laser.com
- www.s-et.com
- www.toyoda-gosei.com/led

Web Sites for the LED UV Lamp Manufacturers for Inkjet Printers

- www.exfo-excelerate.com
- www.Phoseon.com (possibly used on Luscher JetPrint….)
- www.summitUV.com
- www.sun-nsk.com

There is also a company near Boston that has entered this market: www.Luminus.com. But they closed down their LED start-up team the weeks before Christmas 2008.

Web Sites for the UV Lamp Manufacturers for Inkjet Printers

- www.Fusionuv.com
- www.HeraeusAmba.com
- www.Hoenle.com
- www.Nordson.com
- www.Osram.com
- www.Phoseon.com
- www.summitUV.com
- www.uvIntegration.com

Acknowledgments

An earlier version of this report was published by SIP magazine in the FESPA '07 Daily News. Since that date Raster Printers has dropped trying to use LED lamps and Sun LLC in Russia has increased their use of LED lamps.

IMI (USA) and IMI Europe have provided their conference and seminar material to our university, for which FLAAR+BGSU sincerely appreciates.

Nordson's booth at Print '05 provided an abundance of informative handouts.

Fusion UV sent the informative article by Stowe, which helps build up our reference library.

The folks at the Phoseon booth and Integration Technology booth at FESPA '07 were helpful with their answers to my questions. I need to visit both of their headquarters to further my research on UV inkjet curing in general.

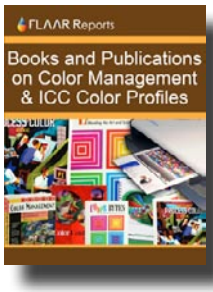
Sun LLC hosted my stay in Russia for training on their LED system in 2007. Sun Chemical (no relationship to Sun LLC in Russia) hosted my visit to the factory of Inca Digital in the UK where the Spyder 150 is manufactured, but since this trip was to study the FastJet printer, and not the Spyder, it will take a return visit to gather specifics on the Spyder's LED system.

Gandinnovations provided airfare and hotel so we could attend Visual Communications Duesseldorf, which enabled us to see more of the lamp systems in their Jeti UV over a five day period (2 days installation and three days of the trade show).

In the last two years it has been possible to visit the factories of NUR (twice, two days each time), Durst (both factories, Brixen and Lienz, total of a week the first time; three times in Lienz and twice in Brixen), Inca Digital and Sun Chemical FastJet next door, GRAPO (three visits, 2006 and twice in 2008, three days each time), L&P in the US and Spuhl in Switzerland, VUTEk (four times) Dilli and D.G.I. in Korea, IP&I, GCC (Taiwan), Gerber Scientific (two days), Oce wide-format printer world headquarters (outside Vancouver), and many other UV printer manufacturers under NDA so we do not list them. Plus additional visits to printshops to inspect printers out in the real world. In many cases FLAAR is under NDA but even when not, if we feel an aspect is shown to us in confidence, we do not publish documentation on that aspect. Fortunately there is a sufficient mass of material that is basic industry knowledge that we can discuss in the FLAAR Reports.

Most recently updated February 2009.

First issued, late 2005. Updated February 2006, October 2006, January 2007 and April 2007. Updated September 2007 based on a week with Sun LLC, a successful integrator of LED lamps for UV curing. Updated March 2008 and again May 2008, September 2008, December 2008, January 2009.



These reports on RIP software and Color Management for serious UV printers are free downloads on all FLAAR web sites (follow the link to 'free downloads') http://www.wide-format-printers.net/reviews_reports_evaluations/free_download.php

RIP, COLOR MANAGEMENT, and ICC Color Profiles options

Once you have a serious UV-curable wide-format printer, you may prefer to have an equally serious RIP software and color management equipment.

The RIP software for simple water-based printers such as Canon, Epson, and HP may not be the same RIP software that could be most effective and productive on a UV-curable flatbed or UV-cured roll-to-roll production printer.

I first noticed Caldera RIP on Gandinnovations UV printers several years ago, then I saw Caldera being used at the Mutoh Europe factory demo room in Belgium.

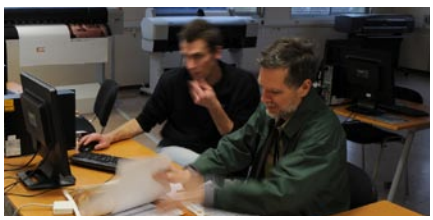
When I was visiting the Durst factories in Europe I again noticed that they were using Caldera RIP software.

So I requested access from Caldera so I could visit their world headquarters in Strasbourg, France, to spend several days learning more about their RIP. As a result there is now a FLAAR Report photo essay on this software.

Most recently I have seen Caldera RIP at the Shanghai printer trade show in China, at DRUPA in Germany, at FESPA DIgital in Geneva, SGIA '08 and Viscom Italy '08.

When I visited a large printshop in Maribor, northern Slovenia, they were using Caldera RIP and the manager of technical services for this company said, "*Caldera does a good job*." This company in Slovenia has about eight UV printers (about five of them from Durst) and an equal number of large solvent printers. They originally used a GretagMacbeth color management system but switched to BARBIERI because the BARBIERI spectrophotometer can read more efficiently and can handle textiles, backlit, wood and other materials that are either awkward or difficult on other brands of color management instruments. You can learn about the BARBIERI equipment either from their headquarters in Brixen or their distributors worldwide.

Caldera also offers a highly regarded spectrophotometer from Barbieri, the leading color management company in Italy (they are headquartered in the same city as Durst, the manufacturer of Rho UV-cured printers).



For further information on Caldera contact Joseph MERGUI
mergui@caldera.fr
If you have questions about color management, if you are in the US you can contact: ImageTech at:
www.ImageTechDigital.com
Mark Spandorf (owner and president), mark@imagetechdigital.com
or 510 238-8905. If you are in Europe or the rest of the world you can contact BARBIERI directly at: BARBIERI electronic snc,
info@BARBIERIelectronic.com
www.BARBIERIelectronic.com
Tel.: +39 0472 834 024
Fax: +39 0472 833 845

Reality Check

Being a university professor for many years does not mean we know everything. But intellectual curiosity often leads us to enter areas that are new to us. So we do not shirk from entering areas where we are obviously not yet expert. If in your years of wide format printing experience have encountered results different that ours, please let us know at ReaderService@FLAAR.org. We do not mind eating crow, though so far it is primarily a different philosophy we practice, because since we are not dependent on sales commissions we can openly list the glitches and defects of those printers that have an occasional problem.

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There is a free PDF that describes the UV-curable inkjet printer Subscription system. Subscriptions are available only for UV-related wide-format printer publications.

FLAAR Reports on UV-curable roll-to-roll, flatbed, hybrid, and combo printers are updated when new information is available. We tend to update the reports on new printers, on printers that readers ask about the most, and on printers where access is facilitated (such as factory visits, demo-room visits, etc).

Reports on obsolete printers, discontinued printers, or printers that not enough people ask about, tend not to be updated.

FLAAR still publishes individual reports on solvent printers, and on giclee printers, but subscriptions on these are not yet available; these FLAAR Reports on solvent, eco-solvent, and water-based wide format printers have to be purchased one by one.

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To obtain a legitimate copy, which you know is the complete report with nothing erased or changed, and hence a report with all the original description of pros and cons, please obtain your original and full report straight from www.FLAAR.org.

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Inclusion in this study by itself in no way endorses any printer, media, ink, RIP or other digital imaging hardware or software. Equally, exclusion from this study in no way is intended to discredit any printer.

Advisory

We do our best to obtain information which we consider reliable. But with hundreds of makes and models of printers, and sometimes when information about them is sparse, or conflicting, we can only work with what we have available. Thus you should be sure to rely also on your own research, especially asking around. Find another trustworthy end-user of the same make and model you need to know about. Do not make a decision solely on the basis of a FLAAR report because your situation may be totally different than ours. Or we may not have known about, and hence not written about, one aspect or another which is crucial before you reach your decision.

The sources and resources we may list are those we happen to have read. There may be other web pages or resources that we missed. For those pages we do list, we have no realistic way to verify the veracity of all their content. Use your own common sense plus a grain of salt for those pages which are really just PR releases or outright ads.

We are quite content with the majority of the specific printers, RIPs, media, and inks we have in the FLAAR facilities. We would obviously never ask for hardware, software, or consumables that we knew in advance would not be good. However even for us, a product which looks good at a trade show, sounds good in the ad literature, and works fine for the first few weeks, may subsequently turn out to be a lemon.

Or the product may indeed have a glitch but one that is so benign for us, or maybe we have long ago gotten used to it and have a workaround. And not all glitches manifest themselves in all situations, so our evaluator may not have been sufficiently affected that he or she made an issue of any particular situation. Yet such a glitch that we don't emphasize may turn out to be adverse for your different or special application needs.

Equally often, what at first might be blamed on a bad product, often turns out to be a need of more operator experience and training. More often than not, after learning more about the product it becomes possible to produce what it was intended to produce. For this reason it is crucial for the FLAAR team and their university colleagues to interact with the manufacturer's training center and technicians, so we know more about a hardware or software. Our evaluations go through a process of acquiring documentation from a wide range of resources and these naturally include the manufacturer itself. Obviously we take their viewpoints with a grain of salt but often we learn tips that are worthy of being passed along.

FLAAR has no way of testing 400+ specifications of any printer, much less the over 101 different UV printers from more than 46 manufacturers. Same with hundreds of solvent printers and dozens of water-based printers. We observe as best we can, but we cannot take each printer apart to inspect each feature. And for UV printers, these are too expensive to move into our own facilities for long-range testing, so we do as best as is possible under the circumstances. And when a deficiency does become apparent, usually from word-of-mouth or from an end-user, it may take time to get this written up and issued in a new release.

Another reason why it is essential for you to ask other printshop owners and printer operators about how Brand X and Y function in the real world is that issues may exist but it may take months for these issues to be well enough known for us to know the details. Although often we know of the issues early, and work to get this information into the PDFs, access to information varies depending on brand and model. Plus with over 300 publications, the waiting time to update a specific report may be several months. Plus, once a printer is considered obsolete, it is not realistic to update it due to the costs involved.

For these reasons, every FLAAR Report tries to have its publication date on the front outside cover (if we updated everything instantly the cost would be at commercial rates and it would not be possible to cover these expenses). At the end of most FLAAR Reports there is additionally a list of how many times that report has been updated. A report with lots of updates means that we are updating that subject based on availability of new information. If there is no update that is a pretty good indication that report has not been updated! With 101 models of UV printers, several hundred solvent printers, and scores of water-based printers, we tend to give priority to getting new reports out on printers about which not much info at all is available elsewhere. So we are pretty good about reporting on advances in LED curing. But glitches in a common water-based printer will take longer to work its way through our system into an update, especially if the glitch occurs only in certain circumstances, for example, on one type of media. With several hundred media types, we may not yet have utilized the problem media. While on the subject of doing your own research, be sure to ask both the printer operator and printshop owner or manager: you will generally get two slightly different stories. A printer operator may be aware of more glitches of the printer than the owner.

But even when we like a product and recommend it, we still can't guarantee or certify any make or model nor its profitability in use because we don't know the conditions under which a printer system might be utilized in someone else's facility. For ink and media, especially after-market third-party ink and media, it is essential that you test it first, under your conditions. We have no way to assure that any ink or media will be acceptable for your specific needs in your specific print shop. As a result, products are described "as is" and without warranties as to performance or merchantability, or of fitness for a particular purpose. Any such statements in our reports or on our web sites or in discussions do not constitute warranties and shall not be relied on by the buyer in deciding whether to purchase and/or use products we discuss because of the diversity of conditions, materials and/or equipment under which these products may be used. Thus please recognize that no warranty of fitness or profitability for a particular purpose is offered.

The user is advised to test products thoroughly before relying on them. We do not have any special means of analyzing chemical contents or flammability of inks, media, or laminates, nor how these need to be controlled by local laws in your community. There may well be hazardous chemicals, or outgassing that we are not aware of. Be aware that some inks have severe health hazards associated with them. Some are hazardous to breathe; others are hazardous if you get them on your skin. For example, some chemicals such as cyclohexanone do not sound like chemicals you want to breathe every day. Be sure to obtain, read, and understand the MSDS sheets for the inks, media, and laminates that you intend to use. Both solvent,

eco-solvent, and UV-curable inks are substances whose full range of health and environmental hazards are not yet fully revealed. It is essential you use common sense and in general be realistic about the hazards involved, especially those which are not listed or which have not yet been described. FLAAR is not able to list all hazards since we are not necessarily aware of the chemical components of the products we discuss. Our reports are on usability, not on health hazards.

Most inks are clearly not intended to be consumed. Obviously these tend to be solvent inks and UV-curable inks. Yet other inks are edible, seriously, they are printed on birthday cakes. Indeed Sensient is a leader in a new era of edible inks. Therefore the user must assume the entire risk of ascertaining information on the chemical contents and flammability regulations relative to inks, media or laminates as well as using any described hardware, software, accessory, service, technique or products.

We have no idea of your client's expectations. What students on our campus will accept may not be the same as your Fortune 500 clients. In many cases we have not ourselves used the products but are basing our discussion on having seen them at a trade show, during visiting a print shop, or having been informed about a product via e-mail or other communication.

Results you see at trade shows may not be realistic

Be aware that trade show results may not be realistic. Trade shows are idealized situations, with full-time tech support to keep things running. The images at a trade show may be tweaked. Other images make be "faked" in the sense of slyly putting on primer without telling the people who inspect the prints. Most UV inks don't stick to all materials; many materials need to be treated.

Or the UV prints may be top-coated so that you can't do a realistic scratch test.

Booth personnel have many standard tricks that they use to make their output look gorgeous. In about half the cases you will not likely obtain these results in real life: in most cases they are printing unidirectional, which may be twice as slow as bi-directional.

Trade show examples tend to be on the absolutely best media. When you attempt to save money and use economy media you will quickly notice that you do not get anywhere near the same results as you saw in the manufacturer's trade show booth, or pictured in their glossy advertisement. Five years ago we noticed Epson was laminating prints to show glossy output because their pigmented inks could not print on actual glossy media. The same equipment, inks, media, and software may not work as well in your facility as we, or you, see it at a trade show. All the more reason to test before you buy; and keep testing before you make your final payment. Your ultimate protection is to use a gold American Express credit card so you can have leverage when you ask for your money back if the product fails.

Images printed at trade show may be in uni-directional mode: so you may not realize the printer has bi-directional (curing) banding defects until you unpack it in your printshop. Bi-directional curing banding is also known as the lawnmower effect. Many printers have this defect; sometimes certain modes can get rid of it, but are so slow that they are not productive.

You absolutely need to do print samples with your own images and the kind provided by your clients. Do not rely on the stock photos provided by the printer, ink, media, or RIP manufacturer or reseller. They may be using special images which they know in advance will look fabulous on their printer. Equally well, if you send your sample images to the dealer, don't be surprised if they come back looking awful. That is because many dealers won't make a serious effort to tweak their machine for your kind of image. They may use fast speed just to get the job done (this will result in low quality). Check with other people in your area, or in the same kind of print business that you do. Don't rely on references from the reseller or manufacturer (you will get their pet locations which may be unrealistically gushy): find someone on your own.

Factors influencing output

Heat, humidity, static, dust, experience level of your workers (whether they are new or have prior years experience): these are all factors that will differ in your place of business as compared with test results or demo room results.

Actually you may have people with even more experience than we do, since we deliberately use students to approximate newbies. FLAAR is devoted to assisting newcomers learn about digital imaging hardware and software. This is why Nicholas Hellmuth is considered the "Johnny Appleseed" of wide format inkjet printers.

Therefore this report does not warranty any product for any quality, performance or fitness for any specific task, since we do not know the situation in which you intend to use the hardware or software. Nor is there any warranty or guarantee that the output of these products will produce salable goods, since we do not know what kind of ink or media you intend to use, nor the needs of your clients. A further reason that no one can realistically speak for all aspects of any one hardware or software is that each of these products may require additional hardware or software to reach its full potential.

For example, you will most likely need a color management system which implies color measurement tools and software. To handle ICC color profiles, you may need ICC color profile generation software and a spectrophotometer since often the stock pre-packaged ICC color profiles which come with the ink, media, printers and/or RIPs may not work in your situation. Not all RIPs handle color management equally, or may work better for some printer-ink-media combinations than for others.

Be aware that some RIPs can only accept ICC color profiles: you quickly find out the hard way that you can't tweak these profiles nor generate new ones. So be sure to get a RIP which can handle all aspects of color management. Many RIPs come in different levels. You may buy one level and be disappointed that the RIP won't do everything. That's because those features you may be lacking are available only in the next level higher of that RIP, often at considerable extra cost. Same thing in the progression of Chevy through Pontiac to Cadillac, or the new Suburbans. A Chevy Suburban simply does not have all the bells and whistles of the Cadillac Escalade version of this SUV.

Don't blame us… besides, that's why we are warning you. This is why we have a Survey Form, so we can learn when you find products that are inadequate. We let the manufacturers know when end users complain about their products so that the manufacturers can resolve the situation when they next redesign the system.

Most newer printer models tend to overcome deficiencies of earlier models. It is possible that our comparative comments point out a glitch in a particular printer that has been taken care of through an improvement in firmware or even an entirely new printer model. So if we point out a deficiency in a particular printer brand, the model you may buy may not exhibit this headache, or your kind of printing may not trigger the problem. Or you may find a work-around.

Just remember that every machine has quirks, even the ones we like. It is possible that the particular kind of images, resolution, inks, media, or other factors in your facility are sufficiently different than in ours that a printer which works just fine for us may be totally unsatisfactory for you and your clients. However it may be that the specific kind of printing you need to do may never occasion that shortcoming. Or, it may be that your printer was manufactured on a Monday and has defects that are atypical, show up more in the kind of media you use which we may not use as often or at all during our evaluations. Equally possibly a printer that was a disaster for someone else may work flawlessly for you and be a real money maker for your company.

So if we inspect a printer in a printshop (a site-visit case study), and that owner/operator is content with their printer and we mention this; don't expect that you will automatically get the same results in your own printshop.

In some cases a product may work better on a Macintosh than on a PC. RIP software may function well with one operating system yet have bugs and crash on the same platform but with a different operating system. Thus be sure to test a printer under your own specific work conditions before you buy.

And if a printer, RIP, media, or ink does not function, return it with no ands, ifs or buts. Your best defense is to show an advertising claim that the printer simply can't achieve. Such advertising claims are in violation of federal regulations, and the printer companies know they are liable for misleading the public.

But before you make a federal case, just be sure that many of the issues are not user error or unfamiliarity. It may be that training or an additional accessory can make the printer do what you need it to accomplish. Of course if the printer ads did not warn you that you had to purchase the additional pricey accessory, that is a whole other issue. Our reviews do not cover accessories since they are endless, as is the range of training, or lack thereof, among users.

The major causes of printer breakdown and failure is lack of maintenance, poor maintenance, spotty maintenance, or trying to jerry-rig some part of the printer. The equally common cause of printer breakdown is improper use, generally due from lack of training or experience. Another factor is whether you utilize your printer all day every day. Most solvent and UV printers work best if used frequently. If you are not going to use your printer for two or three days, you have to put flush into the system and prepare it for hibernation (even if for only four or five days). Then you have to flush the ink system all over again.

Also realize that the surface of inkjet prints are fragile and generally require lamination to survive much usage. Lamination comes in many kinds, and it is worth finding a reliable lamination company and receiving training on their products.

Also realize that no hybrid or combo UV printer can feed all kinds of rigid materials precisely. Some materials feed well; others feed poorly; others will skew.

Although we have found several makes and models to work very well in our facilities, how well they work in your facilities may also depend on your local dealer. Some dealers are excellent; others just sell you a box and can't provide much service after the sale. Indeed some low-bid internet sales sources may have no technical backup whatsoever. If you pay low-bid price, you can't realistically expect special maintenance services or tech support later on from any other dealer (they will tell you to return to where you paid for the product). This is why we make an effort to find out which dealers are recommendable.

Obviously there are many other dealers who are also good, but we do not always know them. To protect yourself further, always pay with a level of credit card which allows you to refuse payment if you have end up with a lemon. A Gold American Express card allows you to refuse payment even months after the sale. This card may also extend your warranty agreement in some cases (check first).

Most of the readers of the FLAAR Reports look to see what printers we use in our own facilities. Readers realize that we will have selected the printers that we like based on years of experience and research. Indeed we have met people at trade shows who told us they use the FLAAR web site reports as the shopping list for their corporate purchases.

Yes, it is rather self-evident that we would never ask a manufacturer to send a product which we knew in advance from our studies was no good. But there are a few other printers which are great but we simply do not have them in our facilities yet.

So if a printer is not made available by its manufacturer, then there is no way we can afford to have all these makes and models in our facility. Thus to learn about models which we do not feature, be sure to ask around in other print shops, with IT people in other corporations, at your local university or community college. Go to trade shows…. but don't use only the booth…ask questions of people in the elevator, in line at the restaurant, anywhere to escape the smothering hype you get in the booth.

Realize that a FLAAR Report on a printer is not by itself a recommendation of that printer. In your local temperature, in your local humidity, with the dust that is in your local air, with your local operator, and with disorientation of the insides of a printer during rough shipment and installation, we have no knowledge of what conditions you will face in your own printshop. We tend to inspect a printer first in the manufacturing plant demo room: no disjointed parts from any shipment since this printer has not been lifed by cranes and run over a rough pot-holed highway or kept in smeltering heat or freezing cold during shipment.

Taking into consideration we do not know the conditions in which you may be using your hardware, software, or consumables, neither the author nor FLAAR nor either university is liable for liability, loss or damage caused either directly or indirectly by the suggestions in this report nor by hardware, software, or techniques described herein because.

Availability of spare parts may be a significant issue

Chinese printers tend to switch suppliers for spare parts every month or so. So getting spare parts for a Chinese printer will be a challenge even if the distributor or manufacturer actually respond to your e-mails at all. Fortunately some companies to have a fair record of response; Teckwin is one (based on a case of two problematical hybrid UV printers in Guatemala). The distributor said that Teckwin sent a second printer at their own expense and sent tech support personnel at their expense also. But unfortunately both the hybrid UV printers are still abandoned in the warehouse of the distributor; they were still there in January 2009. But Teckwin has the highest rating of any Chinese company for interest in quality control and realization that it is not good PR to abandon a client or reseller or distributor all together.

Recently we have heard many reports of issues of getting parts from manufacturers in other countries (not Asia). So just because you printer is made in an industrialized country, if you are in the US and the manufacturer is X-thousand kilometers or miles away, the wait may be many days, or weeks.

Lack of Tech Support Personnel is increasing

The book of sales in the third quarter of 2008 resulted in many tech support problems.

The recession resulted in even more: some manufacturers may need to skimp on quality control during a recession, or switch to cheaper parts suppliers. Plus they are not hiring enough tech support during a recession. So the bigger and more successful the company, in some cases the worse these particular problems may be.

Any new compiled printer may take a few months to break in.

Any new printer, no matter who the manufacturer, or how good is the engineering ane electronics, will tend to have teething issues. Until the firmware is updated, you may be a beta tester. This does not mean the printer should be avoided, just realize that you may have some downtime and a few headaches. Of course the worst case scenario for this was the half-million dollar Luscher JetPrint: so being "Made in Switzerland" was not much help.

Be realistic and aware that not all materials can be printed on equally well

Many materials don't feed well through hybrid (pinch roller on grit roller systems) or combo UV systems (with transport belts). Banding, both from poor feeding, and from bi-directional (lawnmower effect) are common on many UV-curable inkjet printers.

It is typical for some enthusiastic vendors to claim verbally that their printer can print on anything and everything. But once you unpack the printer and set it up, you find that it requires primer on some materials; on other materials it adheres for a few weeks but then falls off.

And on most hybrid and many combo printers, some heavy, thick, or smooth-surfaced materials skew badly. Since the claim that the printer will print on everything is usually verbal, it is tough to prove this aspect of misleading advertising to a jury.

Not all inks can print on all materials. And at a trade show, many of the materials you see so nicely printed on, the manufacturer may be adding a primer at night or early in the morning: before you see the machine printing on this material.

We feel that the pros and cons of each product speak more than adequately for themselves. Just position the ad claims on the left: put the actual performance results on the right. The unscrupulous hype for some printers is fairly evident rather quickly.

Be sure to check all FLAAR resources

Please realize that with over 200 different FLAAR Reports on UV printers, you need to be sure to check the more obscure ones too. If a printer has a printhead issue, the nitty gritty of this may be in the FLAAR Report on printheads. The report on the model is a general introduction; if we discussed the intimate details of printheads then some readers might fall asleep. And obviously do not limit yourself to the free reports. The technical details may be in the reports that have a price to them. Our readers have said they prefer to have the general basics, and to park the real technical material in other reports that people can buy if they really want that level of information.

So it may be best to ask for personal consulting. The details of the problems with the ColorSpan 5400uv series are rather complex: namely the center row of the Ricoh printheads. This would require an expensive graphic designer and consultants to show the details. And the design of the printhead would probably be altered by the time we did any of this anyway. So it is essential to talk with people: with other end-users, and with FLAAR in person on a consulting basis.

Acknowledgements

With 15 employees the funding has to come from somewhere, so we do welcome project sponsorship, research grants, contributions that facilitate our educational programs, scholarships for co-op interns and graduate students, and comparable project-oriented funding from manufacturers. The benefit for the end-user is a principle called academic freedom, in this case,

- The freedom of a professor or student to speak out relative to the pros and cons of any equipment brought to them to benchmark.
- The freedom to design the research project without outside meddling from the manufacturer.

Fortunately, our budget is lean and cost effective as you would expect for a non-profit research institute. As long as we are not desperate for money we can avoid the temptation to accept payment for reprinting corporate PR hype. So the funding is used for practical research. We do not accept (nor believe) and certainly do not regurgitate corporate PR. For example, how many manufacturer's PR photos of their products have you seen in our reports or on our web sites?

Besides, it does not take any money to see which printers and RIPs function as advertised and which don't. We saw one hyped printer grind to a halt, malfunction, or otherwise publicly display its incapabilities at several trade shows in a row. At each of those same trade shows another brand had over 30 of their printers in booths in virtually every hall, each one producing museum quality exhibits. Not our fault when we report what we see over and over and over again. One of our readers wrote us recently, "Nicholas, last month you recommended the …… as one of several possible printers for our needs; we bought this. It was the best capital expenditure we have made in the last several years. Just wanted to tell you how much we appreciate your evaluations…."
FLAAR is a non-profit educational and research organization dedicated for over 36 years to professional photography in the arts, tropical flora and fauna, architectural history, and landscape panorama photography.

Our digital imaging phase is a result of substantial funding in 1996 from the Japanese Ministry of Public Education for a study of scanning and digital image storage options. This grant was via Japan's National Museum of Ethnology, Osaka, Japan. That same year FLAAR also received a grant of $100,000 from an American foundation to do a feasibility study of digital imaging in general and the scanning of photographic archives in particular.

The FLAAR web sites began initially as the report on the results of these studies of scanners. Once we had the digital images we began to experiment with digital printers. People began to comment that our reports were unique and very helpful. So by 1999 we had entire sections on large format printers.

FLAAR has existed since 1969, long before inkjet printers existed. Indeed we were writing about digital imaging before HP even had a color inkjet system available. In 2000 FLAAR received an educational grant from Hewlett-Packard large format division, Barcelona, Spain, for training, for equipment, and to improve the design and navigation on the main web sites of the FLAAR Network. This grant ran its natural course, and like all grants, reached its finishing point, in this case late 2005.

In some cases the sponsorship process begins when we hear end-users talking about a product they have found to be better than

other brands. We keep our ears open, and when we spot an especially good product, this is the company we seek sponsorship from. It would not be wise of us to seek sponsorship from a company with a sub-standard or otherwise potentially defective printer. So we usually know which printers are considered by end-users to be among the better brands before we seek sponsorship. After all, out of the by now one million readers, we have heard plenty about every single printer out there.

We thank MacDermid ColorSpan (now part of HP), Hewlett-Packard, Parrot Digigraphic, Color DNA, Canon, Gandinnovations, and other companies for providing funding for technology training for the FLAAR staff and our colleagues at Bowling Green State University and for funds to allow us to attend all major international trade shows, which are ideal locations for us to gather information. We thank Sun LLC, Caldera, Raster Printers (Rastek), DEC LexJet, DigiFab, Barbieri electronic, Mutoh Europe, IP&I, Dilli, Yuhan-Kimberly, InkWin, GCC, Grapo, Durst, Teckwin and Zund for providing funds so that we can make more of our publications free to end-users. During 2000-2001 we had grants to cover all the costs of our publications, and all FLAAR Reports were free in those early years. As that early grant naturally expired after a few years, we had to begin charging for some of our reports to cover costs. Now (in 2009), we are seeking corporate sponsorship so we can gradually make another 20% of our publications free to our readers.

Since 2006 we do a major part of our evaluations at a factory and headquarters demo room. Since the university does not fund any of these trips, it is traditional for the manufacturer to fund a research sponsorship. In the US this is how most university projects are initiated for decades now, and it is increasing. In fact there is a university in Austria that is not an “edu” but is a “GmbH”, funded by the chamber of commerce of that part of Austria. In other words, a university as an educational institution, but functioning in the real world as an actual business. This is a sensible model.

It has been helpful when companies make it possible for us to fly to their headquarters so we can inspect their manufacturing facilities, demo rooms, and especially when the companies make their research, engineering and ink chemistry staff available for discussions. When I received my education at Harvard I was taught to have a desire to learn new things. This has guided my entire life and is what led me into wide-format digital imaging technology: it is constantly getting better and there is a lot to learn every month. Thus I actively seek access to improving my understanding of wide format printer technology so that we can better provide information to the approximately quarter-million+ readers of our solvent and UV printer web site (www.large-format printers.org) and the over half a million who read either our wide-format-printers.org site or our roughly half million combined who read our digital-photography.org and www.FineArtGicleePrinters.org sites.

Barbieri electronic (color management), Caldera (RIP), ColorSpan, DEC, Durst, Gerber, Grapo, IP&I, Mimaki USA, Mutoh, Dilli, GCC, NUR, Oce, Shiraz (RIP), Sun, Teckwin, VUTEk, Xerox, Yuhan-Kimberly, Zund have each brought FLAAR staff to their headquarters and printer factories. Bordeaux, InkWin and Sunflower ink have brought us to inspect their ink manufacturing facilities and demo rooms. We have visited the world headquarters and demo rooms of HP in Barcelona and received informative and helpful technology briefings. We are under NDA as to the subjects discussed but it is important that we be open where we have visited. Mimaki Europe has had FLAAR as their guest in Europe to introduce their flatbed UV printer, as have other UV-curable manufacturers, again, under NDA as to the details since often we are present at meetings where unreleased products are discussed. Xaar has hosted an informative visit to their world headquarters in the UK. You don’t get this level of access from a trade magazine writer, and I can assure you, we are provided much more detailed information and documentation in our visits than would be provided to a magazine author or editor. Companies have learned that it’s a lot better to let us know up front and in advance the issues and glitches with their printers, since they now know we will find out sooner or later on our own. They actually tell us they realize we will find out on our own anyway.

Contributions, grant, sponsorships, and project funds from these companies are also used to improve the design and appearance of the web sites of the FLAAR Information Network. We thank Canon, ColorSpan, HP, ITNH, and Mimaki for providing wide format printers, inks, and media to the universities where FLAAR does research on wide format digital imaging. We thank Epson America for providing an Epson 7500 printer many years ago, and Parrot Digigraphic for providing three different models of Epson inkjet printers to our facilities on loan at BGSU (5500, 7600, 7800). We thank Mimaki USA for providing a JV4 and then a Mimaki TX-1600s textile printer and Improved Technologies (ITNH) providing their Ixia model of the Iris 3047 giclee printer.

We thank 3P Inkjet Textiles and HP for providing inkjet textiles so we could learn about the different results on the various textiles. IJ Technologies, 3P Inkjet Textiles, ColorSpan, Encad, HP, Nan Ya Pepa, Oracal, Tara and other companies have provided inkjet media so we can try it out and see how it works (or not as the case may be; several inkjet media failed miserably, one from Taiwan, the other evidently from Germany!). We thank Aurelon, Canon, ColorGate, ColorSpan, ErgoSoft, HP, PerfectProof, PosterJet, Onyx, Ilford, CSE ColorBurst, ScanvecAmiable, Wasatch and many other RIP companies for providing their hardware and software RIPs.

We thank Dell Computers for providing awesome workstations for testing RIP software and content creation with Adobe Photoshop and other programs. We also appreciate the substantial amount of software provided by Adobe. As with other product loaned or provided courtesy of ProVar LLC (especially the 23” monitors which makes it so much easier to work on multiple documents side by side).

We thank Betterlight, Calumet Photographic, Global Graphics, Westcott, Global Imaging Inc. Phase One, and Bogen Imaging for helping to equip our archaeological photo studios at the university and its archaeology museum in Guatemala. Heidelberg, Scitex, CreoScitex (now Kodak) and Cruse, both in Germany, have kindly provided scanners for our staff to evaluate.

We really liked some of the results whereas some of the other products were a bit disappointing. Providing samples does not influence the evaluations because the evaluators are students, professors, and staff of Bowling Green State University. These personnel are not hired by any inkjet printer company; they were universities employees (as was also true for Nicholas Hellmuth). The testing person for the HP ColorPro (desktop printer) said he frankly preferred his Epson printer. When we saw the rest results we did not include this Heweltt-Packard ColorPro printer on our list of recommended printers, but we love our HP DesignJet 5000ps so much we now have two of them, one at each university.

Sometimes we hear horror stories about a printer. The only way we can tell whether this is the fault of the printer design, or lack of training of the operator, is to have the printer ourselves in-house. Of course some printer manufacturers don’t understand the reasons we need to have each make and model; they are used to loaning their demo units for a week or so. That is obviously inadequate for a serious review.

Some of the media provided to us failed miserably. Three printers failed to meet common sense usability and printability standards as well (HP 1055, one older desktop model (HP Color Pro GA), and

one Epson). Yet we know other users who had better results; maybe ours came down the assembly line on a Monday or Friday afternoon, when workers were not attentive. One costly color management software package was judged "incapable" by two reviewers (one from the university; second was an outside user who had made the mistake of buying this package).

So it's obvious that providing products or even a grant is no shield from having your products fail a FLAAR evaluation. The reason is clear: the end user is our judge. The entire FLAAR service program is to assist the people who need to use digital imaging hardware and software. If a product functions we find out and promulgate the good news. If a product is a failure, or more likely, needs some improvement in the next generation, we let people know. If a product is hyped by what an informed user would recognize as potentially false and misleading nonsense, then we point out the pathetic discrepancies very clearly.

This is what you should expect from an institute which is headed by a professor.

Actually, most of our reviews are based on comments by end users. We use their tips to check out pros and cons of virtually every product we discuss. You can't fool a print shop owner whose printer simply fails to function as advertised. And equally, a sign shop owner who earns a million dollars a year from a single printer brand makes an impact on us as well. We have multiple owners of ColorSpan printers tell us that this printer is their real money earner for example. We know other print shops where their primarily income is from Encad printers. Kinkos has settled on the HP 5000 as its main money maker production machine, and so on.

Yet we have documentation of several print shop companies whose business was ruined by specific brands that failed repeatedly. It is noteworthy that it is always the same brand or printer at both locations: one due to banding and printheads then simply no longer printing one color; the other brand due to pokiness of the printer simply not being competitively fast enough. Same with RIPs, we have consistent statements of people using one RIP, and only realizing how weak it was when they tried another brand which they found substantially better. Thus we note that companies which experiment with more than one brand of product tend to realize more quickly which brand is best. This is where FLAAR is in an ideal situation: we have nine RIPs and 25 printers. Hence it is logical that we have figured out which are best for our situation.

Grant funding, sponsorship, demonstration equipment, and training are supplied from all sides of the spectrum of printer equipment and software engineering companies. Thus, there is no incentive to favor one faction over another. We receive support from three manufacturers of thermal printheads (Canon, ColorSpan and HP) and also have multiple printers from three manufacturers of piezo printers (Epson, Mutoh, and Mimaki). This is because piezo has definite advantage for some applications; thermal printheads have advantages in different applications. Our reviews have universal appeal precisely because we feature all competing printhead technologies. Every printer, RIPs, inks, or media we have reviewed have good points in addition to weaknesses. Both X-Rite and competitor GretagMacbeth provided spectrophotometers. Again, when all sides assist this program there is no incentive to favor one by trashing the other. Printer manufacturer ad campaigns are their own worst enemy. If a printer did not make false and misleading claims, then we would have nothing to fill our reviews with refuting the utter nonsense that is foisted on the buying public.

It is not our fault if some printers are more user friendly, print on more media than other brands. It is not our fault that the competing printers are ink guzzlers, are slow beyond belief, and tend to band or drop out colors all together. We don't need to be paid by the printer companies whose products work so nicely in both our universities on a daily basis. The printers which failed did so in front of our own eyes and in the print shops of people we check with. And actually we do try to find some redeeming feature in the slow, ink gulping brands: they do have a better dithering pattern; they can take thick media that absolutely won't feed through an HP. So we do work hard at finding the beneficial features even of printers are otherwise get the most critique from our readers. Over one million people will read the FLAAR Information Network in the next 12 months; 480,000 people will be exposed to our reports on wide format printers from combined total of our three sites on these themes. You can be assured that we hear plenty of comments from our readers about which printers function, and which printers fail to achieve what their advertising hype so loudly claims.

We turn down offers of funding every year. These offers come from PO Box enterprises or products with no clearly visible point of manufacture. Usually the company making the offer presumes they can buy advertising space just by paying money. But that is not what our readers want, so we politely do not accept such offers of money.

Contributions, grants, sponsorships, and funding for surveys, studies and research is, however, open to a company who has an accepted standing in the industry. It is helpful if the company has a visible presence at leading trade shows and can provide references from both end users and from within the industry. Where possible we prefer to visit the company in person or at least check them out at a trade show. Obviously the product needs to have a proven track record too. Competing companies are equally encouraged to support the FLAAR system. We feel that readers deserve to have access to competing information. Competition is the cornerstone of American individualism and technological advancement.

FLAAR also covers its costs of maintaining the immense system of 8 web sites in three languages and its facilities in part by serving as a consultant such as assisting inkjet manufacturers learn more about the pros and cons of their own printers as well as how to improve their next generation of printers. It is especially useful to all concerned when manufacturers learn of trends (what applications are popular and for what reasons). For example, manufacturers need to know whether to continue designing software for Mac users, or concentrate software for PC users. So the survey form that you fill out is helpful to gather statistics. You benefit from this in two ways: first, you get the FLAAR reports in exchange for your survey form. Second, your comments bring (hopefully) change and improvement in the next generation of printers. When we do survey statistics, then the names, addresses, and telephone numbers are removed completely. A survey wants only aggregate numbers, not individuals. However, if you ask about a specific brand of printer, and do not opt out, we forward your request to a pertinent sponsor so you can obtain follow-up from that brand, since we ourselves do not have enough personnel to respond to each reader by telephone. But we do not provide your personal information to outsiders and our survey form has an opt out check-off box which we honor.

FLAAR also serves as consultants to Fortune 500 companies as well as smaller companies and individuals who seek help on which printers to consider when they need digital imaging hardware and software.

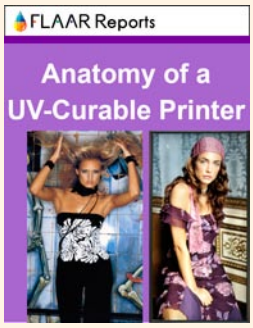
A modest portion of our income comes from our readers who purchase the FLAAR series. All income helps continue our tradition of independent evaluations and reviews of inkjet printers, RIPs, media, and inks.

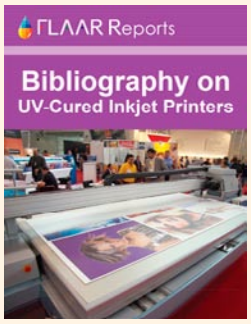
These are some of the most

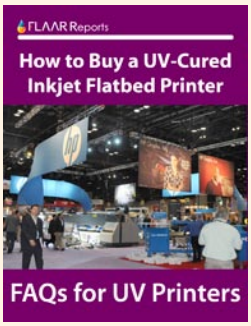
Recent FLAAR Reports (2007-2009)

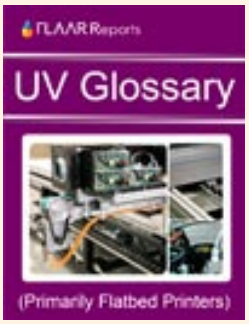
You can find these and more reports at: www.wide-format-printers.NET

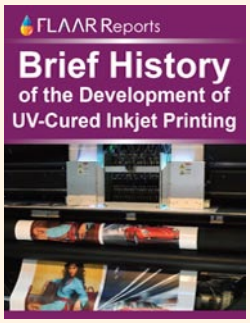
Introduction to UV Curable Inkjet Flatbed Printers

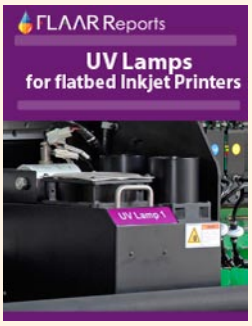


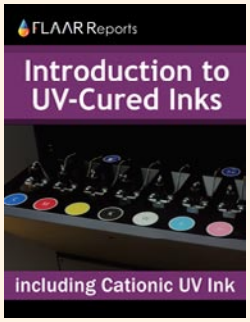












Comments on UV Inkjet Printers at Major Trade Shows 2007-2009

These are some of the most

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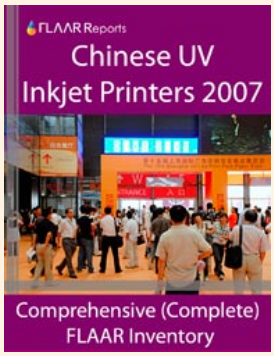
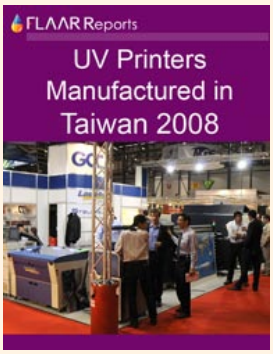
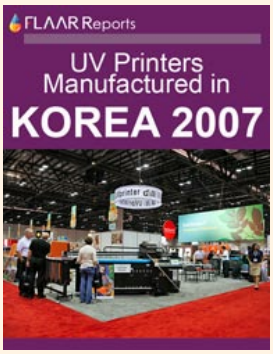
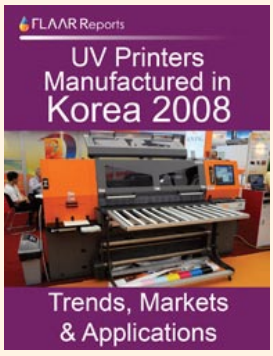
UV Printers Manufactured in China, Korea and Taiwan









Most recent UV Printers