The Fine Art of Digital Printing, Part 3

By David Em

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The printing industry's recently coined a new acronym: DFA, which stands for Digital Fine Art. A DFA printer should deliver uncompromising image quality, work with a variety of media, and create prints that last a lifetime. DFA printers are typically inkjets, since they provide the best detail, color range, and media options.

The big four inkjet manufacturers (Epson, HP, Canon, and Lexmark) all have products with impressive specs on the market, but when it comes to figuring out which printer to buy, and what inks and papers to stock it with, it's a jungle out there.

Inkjet technology's come a long way over the last ten years. What was once marginal image quality is now superb, print life has jumped from months to decades (and in some cases, centuries), and the astronomical prices of yore are now consumer-friendly. This week I'll explore what it takes to produce "museum quality" prints on your desktop, and examine some of the pitfalls you'll encounter along the way.

Print Quality

Overall image quality varies from model to model, but printer resolution is quickly becoming a non-issue. With droplet sizes as small as two or three picoliters, most new printers deliver more detail than the human eye perceives. For example, many Epson printers output at either 1440 or 2880 dpi, but very few people can see the difference unless the print is viewed through a magnification loupe. Even very inexpensive inkjet printers now provide image detail that's equal to or better than any traditional printing or photographic process.

Of course, there's much more to a great looking print than mere detail. Color gamut, tonal range, surface quality, and permanence are equally critical elements of a printed image. These properties depend on the inks an image is printed with and the physical media it's printed on.

Each printer manufacturer uses proprietary inks, all of which have different properties. And just as the chemicals that go into film emulsions such as Kodachrome are tweaked by the manufacturer over time, the chemistry in inkjet cartridges can change too.

To further complicate matters, there's a host of players like Fuji, Kodak, Lyson, Arches, and others that manufacture third party inks and papers that purport to be either cheaper or better than those offered by the printer manufacturers. Since consumables are the life blood of the inkjet printing market, the economic stakes for the companies that make these products are huge.

Choosing the Right Printer

Many people ask me what printer they should buy. There's no right answer to this question because different people have different needs, especially when it comes to producing DFA-quality prints. The right way to select a DFA printer is to figure out what kind of prints you intend to produce first, then work your way backwards.

For instance, if you plan to exclusively produce 8" x 10" glossy photographs, your choices are much wider than if you want the same printer to also produce matte images on heavy stock. If you want to create long panoramas, you'll need a roll paper feeder. And so on.

Because each paper and ink set has its own chemistry, mixing and matching papers and inks from a variety of sources is a journey into the unknown. Companies like Epson and Hewlett-Packard formulate their papers to work with highly specific ink sets. For example, a paper might have an additive in it precisely targeted to protect the longevity of a particular magenta dye that would otherwise be fugitive.

Third Party Papers

As I mentioned above, third parties such as Fuji make papers too. I tested their Premium Plus glossy photo paper, which produced some very nice results. However, I was never able to get an ICC profile for it or any information from Fuji about its archival characteristics. Companies like Dell sell papers whose origins are obscure.

Kodak is aggressively promoting their new swellable Ultima paper as the ultimate solution for inkjet quality and longevity, regardless of what printer it's used in. A press release says that "when used with the latest inks from various manufacturers, photos printed on the paper will last for more than 100 years in typical home display without protection from gas and humidity," even if left unprotected on a table.

Ultima paper may very well have some excellent archival qualities, but no paper will improve the properties of a fade-prone ink. When I asked a Kodak representative if he felt comfortable making the 100 year claim with Lexmark's latest inks, he said that realistically six years might be more like it. I strongly recommend only working with papers and inks that are clearly certified by the printer manufacturer to work together.

Testing for Permanence

For a long time, the inkjet industry focused its efforts on image quality. Now that problem's effectively solved, and attention has moved to image permanence. Obviously all efforts to determine print longevity are theoretical to the extent that no one knows if a print will really last 100 years until 100 years have gone by. Surprisingly, there is still no ANSI/ISO testing standard in place, although I'm told various committees are working toward one.

The most comprehensive data related to inkjet longevity comes from Henry Wilhelm, a pioneer of photo archivality testing. His company, Wilhelm Imaging Research, tests printers, inks, and papers from a wide variety of companies, rates them for lightfastness, and publishes the results on its web site.

Wilhelm tests media for four discrete factors that contribute to image fading: light, temperature, humidity, and ozone. Synergy is a fifth factor that's harder to measure. For example, he's discovered that humidity accelerates ozone degradation.

Wilhelm's testing procedure has been adopted by virtually every major printing company, including Epson, Canon, Fuji, HP, AGFA, Konica, and the other usual suspects, making it a de facto standard for the time being. Only Kodak uses a different system. As a result, "Kodak years" must be interpreted differently from "Wilhelm years."

Test Standards

Both Wilhelm and Kodak test for all four factors. However, where Kodak uses a light exposure system based on exposing a print to 120 lux of light for twelve hours a day, Wilhelm's method employs 450 lux for the same period of time.

According to HP, both in its and Wilhelm's tests of the HP Premium Plus papers that are rated with a life expectancy of 73 years, the limiting factor is light. In this case, where light is the most important factor in determining a print's life, the Kodak method yields a life expectancy calculation four times as long as HP's.

Another difference in testing methodology is that Kodak uses a single optical density to test with, where the Wilhelm system uses three. Typical DFA prints and photographs have varying ink distribution densities, and even if only part of a picture fades, its exhibition and resale potential are greatly reduced.

Attack of the Light Brigade

In addition to lower light levels, Kodak's system assumes prints are exhibited with UV filtration, which is not always the case. If an image is directly exposed to the sun, such as in a store window, UV damage can be devastating. However, this effect is greatly mitigated in most home viewing environments, where the light radiation is reflected and absorbed by walls and rugs and so forth. I've been told that UV often drops to near zero in this situation.

On the other hand, a living room in Dallas with a nice big skylight might yield very different results. Two things everyone does agree on is that any kind of storage or framing cuts the air fastness issue to near zero, and pictures kept in boxes or albums have every chance of outlasting their owners.

Some Great Papers

Of the four printer manufacturers mentioned above, HP and Epson offer the best ink and paper choices for DFA printing. Some Canon offerings feature excellent resolution, but their paper choices are limited. Lexmark's inks are not known for their lightfastness, and they don't brand their own paper.

Inkjet paper coatings are either "microporous" or "swellable." Porous coatings dry quickly and have good moisture resistance, but are susceptible to ozone. Swellable papers provide greater lightfastness and are more stable when it comes to pollutants, but they're sensitive to humidity. Brilliant white papers use brighteners that fluoresce blue and absorb harmful ultraviolet radiation—a yellower paper with less brightener will have a longer life.

Used with the right inks, some inkjet papers far outperform traditional color photographs. HP's cotton base matte Photo Rag, produced for its Designjet 5000 and 5500 large-scale printers in partnership with Germany's Hahnemuhle, is rated to last an astonishing 240 years when used with its pigmented UV inks. Another impressive large format inkjet HP paper is its instant-dry HP Productivity Semi-Gloss that's rated at over 200 years.

Epson's line of pigmented UltraChrome ink printers range in size from the 13" x 19" bed $699 Stylus Photo 2200 up to the 44" wide $4,995 Stylus Pro 9600. Epson offers nearly two dozen photographic and DFA papers for this series of printers, including Epson Ultrasmooth Fine Art paper, which is rated to last over 100 years. A matte paper I'm very impressed with is Epson's acid-free Velvet Fine Art matte cotton rag paper, which can last up to 125 years when protected by UV glass, and 180 years with a protective spray. It also has great body.

In dark-keeping such as a box or album, most of Epson' papers are rated to last over 200 years. This matchup of printers, papers, and inks across its UltraChrome ink printer line lets you create perfect small proofs on the desktp Stylus 2200 before producing a final print on the 9600.

Dyes vs. Pigments

Inkjet dye and pigment inks have a big advantage over traditional color photographic processes. Because there's no intermediary processing stage, the colorants go directly from the ink cartridge to paper, yielding better brightness and permanence. On the other hand, inkjet media tend to be highly absorbent, since that's part of how the technology works.

For years, the conventional wisdom has been that dye-based inks are brighter than pigmented ones, and pigments always outlast dyes. To everyone's surprise, including the R&D community, new data reveals that's not always the case. For example, dyes exhibit superior color rendition along the yellow/magenta/red/orange axis, but pigments often win out in the blue/purple range, something we've confirmed with tests in our lab.

HP's developed a lush new set of dyes for its $1900 24" bed 130nr printer. Its prints are rated to last 73 years when used with HP's Premium Plus photo paper. I've also tested HP's #59 black and white photo dye cartridge in its Photosmart 7960 printer. The 7960's color prints also last 73 years, but its black and whites are rated for a jaw-dropping 115 years.

Compared to pigments, dyes are an order of magnitude more susceptible to fading when you randomly mix and match papers and inks. Where pigments may be about three times as sensitive to this kind of situation, dyes may be twenty to thirty times as susceptible.

Dyes and pigment also reveal noticeably different surface properties. Pigmented surfaces are easier to scratch and often display uneven surfaces in mixed color and tone areas. They're also more subject to a phenomenon known as metamerism, which causes what should be neutral grays to display a marked color cast under different lighting conditions, often skewed toward the green range.

On the plus side, pigmented inks increase paper choices over dyes at present. Most of the really cool DFA papers are designed to work with pigments, while most dyes are paired with gloss or satin photographic papers and a very limited set of matte surfaces.

Pigmented inks do offer some unique qualities. For example, Epson's Ultrachrome matte black simulates perfectly the effect of a Rembrandt etching made with a steel plate and printer's ink. A very nice feature of their new $1,795 17"-wide bed Stylus Pro 4000 is that it intelligently switches between a matte black cartridge and a glossy Photo Black one depending on what paper's loaded in the printer.

Some of this media choice imbalance is due to a market perception that higher end printers are supported by the prepress and proofing markets, which have more limited requirements than the DFA market, and some of it has to do with backwards compatibility issues with earlier printers. A couple years down the road, this scenario could be very different.

Conclusions

We've rocketed from out of the Stone Age and into the Modern Era of inkjet printing, but I expect the best is yet to come: Color fidelity will improve and print life expectancy will continue to grow over the next several years.

Producing DFA prints requires more work than simply hitting Print and seeing what comes out the other end of the paper tray, but creating museum-quality prints on your desktop is now unquestionably a reality. Even if you're not producing timeless art, there's no reason your family pictures shouldn't look as good as possible and last as long as possible.

Contributing editor David Em's digital art has beenexhibited in museums andbroadcast in

America, Europe, and Japan. You can e-mail David Em at: davidem@earthlink.net. For more of his (and associateAlex Pournelle's) columns, visit the Media Lab ColumnIndex.

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