

An Interview with  
Henry Wilhelm

# Will my inkjet prints last as long as traditional photos?

© 2003 Bill Nellans

BY DR. RAY WORK

*YES, but only if you choose  
printers, inks, and papers wisely*

It's hard to believe that it's been just 10 years since the first inkjet printers capable of printing photorealistic images were introduced. Today, inkjet-reproduced photos can be found everywhere—in indoor applications ranging from family portraits, wedding albums, art exhibitions and in-store signage to outdoor billboards and supersized wall murals.

But as that classic rock song reminds us: “You ain’t seen nothin’ yet.” Digital camera sales are skyrocketing, and so is interest in inkjet photo reproduction. Many people are already asking: “Are inkjet-printed photos as good as the ones I can get from the drug store or photo lab?”

It's a valid question, because so far, some inkjet-printing marketing claims have proven to be either vaguely misleading or downright false. And the situation is only bound to get worse as some not-so-scrupulous suppliers seek to make a fast buck in a booming market.

Respected image-permanence experts such as Henry Wilhelm and Dr. Ray Work agree that inkjet printers are now technologically capable of outputting continuous-tone photographs that, in terms of image quality, are every bit as good as, or even better

than, what can be achieved with traditional photo processing.

The trouble is: You can't assume that you'll automatically get the same high-quality, long-lasting results with just any off-the-shelf inks and/or papers.

Buyers of inkjet printers and supplies should beware. Some marketing claims deliberately over-simplify complex image-permanence issues for the sake of making a quick sale. And, some users of inkjets have been burned by marketing claims that were made before all of the technical differences between traditional photography and inkjet photography were fully understood.

In 2000, buyers of a new Epson 6-ink dye-based photo printer that used dye-based inks and the then newly-introduced glossy “instant dry” microporous paper were distressed to see that prints they had been led to expect would last 9 to 10 years were changing colors within a matter of days. The culprit behind the fast-deteriorating dye images on microporous media turned out to be the effect of small levels of atmospheric ozone, which can be found in many urban areas.

Traditional photographic prints had never been affected by ozone to any noticeable degree, and this new and never-

before-seen mode of image deterioration caught everyone in the industry off guard, including both Epson and Wilhelm Imaging Research, Inc., the pre-eminent test laboratory for evaluating the lightfastness of photographic papers. This was soon understood to be a classic example of a brand new technology with a brand new image deterioration problem. True, Wilhelm's light stability test data was stated to be only for prints framed behind glass (and therefore protected from ambient ozone), but people do not always display their prints behind glass.

Wilhelm Imaging Research is currently developing standardized tests that will not only measure the light stability of images printed with different combinations of inks and media, but will also test the effects of other known causes of inkjet image deterioration, including ozone, humidity, and certain chemicals used in paper manufacturing. Wilhelm Imaging Research also has begun evaluating the effectiveness of various image-protection methods, such as clearcoat sprays, varnishes and laminating films.

Henry Wilhelm, founder of Wilhelm Imaging Research, has been involved in photographic-preservation research since 1965 and was recently profiled in the *Wall Street Journal* as a pioneer in inkjet image permanence research.

*Great Output* magazine thought it would be interesting if Mr. Wilhelm were interviewed by a fellow pioneer in inkjet-printing research—Dr. Ray Work. Work is a PhD-level chemist and independent consultant who advises many manufacturers of inkjet media and inks. A long-time DuPont employee, Work is credited with initiating and leading the development of DuPont's inkjet-ink-manufacturing business in 1995.

Excerpts from Dr. Work's interview with Wilhelm are published here. Look for additional excerpts in the members-only section of the PDIA web-site.

Wilhelm and Work aren't the only ones with strong views on inkjet-stability testing. Many concerned professionals advocate different approaches to inkjet-product testing, including narrowing the definition of "noticeable fading" and revising how projections of image longevity are reported.

Some of these points of contention are being hashed out in national and international committees that are attempting to establish standards for testing different variables of inkjet photo reproduction. We'll include some of these alternative points of view in future issue of *Great Output*, because we believe that establishing a more open dialogue about image-permanence issues can only help today's digital-imaging enthusiasts become even more enthusiastic. —Eileen Fritsch, Editor

*"You can't assume that you'll automatically get the same high-quality, long-lasting results with just any off-the-shelf inks and/or papers"*

**WORK:** When one reads in product literature that a certain ink or media has been "Wilhelm-tested," what is the reader supposed to think? What does that phrase mean?

**WILHELM:** Up to this point, it has come to imply a standard, indoor light-stability test. We consistently apply the same set of conditions to everything we test. Products are exposed to lab-filtered cool-white fluorescent illumination extrapolated to 12 hours a day exposure at a brightness level of 450 lux. Tests are conducted in rooms maintained at 75°F and 60% humidity.

We also currently use a subset of other filters that could preview other factors that affect light stability and exacerbate color-balance shifts.

In the future, we'll be much more comprehensive and start looking at many aspects other than light stability. We have xenon-arc tests that simulate bright daylight through window glass, and we'll look at other image-permanence parameters such as ozone-fastness, humidity-fastness, and water-fastness. We'll also be looking at the yellowing behaviors of papers. We're moving quite rapidly in all of these areas.

**WORK:** So the term Wilhelm-tested should no longer be construed simply to refer to lightfastness?

**WILHELM:** No it shouldn't, because that represents only one of the many important areas of image permanence.

We've been trying, not yet with complete success, to get everyone who publishes our data to label our indoor light-stability figures as **Display Permanence Ratings**. These ratings are analogous to the miles-per-gallon figures provided to buyers of automobiles. The miles-per-gallon figures for highway and city driving are the result of standardized tests put together by two different government agencies. These numbers allow consumers to make apples-to-apples comparisons of one brand of automobile to the next.

Imagine the confusion that could result if each car manufacturer designed its own tests. There would be tremendous incentives for manufacturers to design tests that would show continually increasing miles-per-gallon ratings for their own products.

Note that miles-per-gallon ratings don't guarantee that a particular driver will ever achieve exactly those numbers. But the ratings do come standardized tests done across the board and can be an important factor in buying decisions. We look at our display permanence ratings to be very similar.

**WORK:** Why do you prefer to use the term display permanence rating? Isn't that the same thing as image permanence?

**WILHELM:** If you were to consider the average display conditions for all color photographs, you would realize that most photographs aren't displayed at all. Most are kept in albums and in shoeboxes. In these environments, light fade may not be an issue, but the images could still be exposed to other damaging elements such as high relative humidity levels.

Also, in the real world, both consumers and museums like to put their most important photographs on display, and they tend to display them for a long time.

I found an interesting statistic that the Photo Marketing Association published a few years ago, in which they estimated that more than 40% of all photographers on display in people's homes were on refrigerator doors—totally without glass or plastic filters.

The objective of our display permanence rating system is to obtain realistic and meaningful comparisons of existing products and interpret what type of performance buyers of those products can expect under a variety of display conditions.

For example, putting images up on refrigerator doors is a major display condition that we have to take into account.

**WORK:** How is it possible to establish standardized tests when prints are displayed so many different ways? Wouldn't it be reasonable to develop different tests for different markets?

**WILHELM:** Yes, it is difficult to develop standards. The entire basis of using accelerated testing to evaluate image permanence is to try to relate essentially everything in the real world that can affect inkjet prints, which we now know conclusively includes light, thermal aging (dark storage), ozone, humidity and water. Prints can also be exposed to many different types of lighting, including halogen, different types of fluorescent lighting, and of course daylight, which could even be direct sunlight for a part of the day.

For the light-stability test, we have standardized on an exposure of 450 lux for 12 hours a day, which would be characteristic of a fairly brightly illuminated room. That's not to say that there aren't common situations that have much higher illumination levels than that. Likewise, there are display environments that have lower illumination levels.

But our 450 lux illumination level for 12 hours a day is a good standardized test. And in fact, almost every major imaging

manufacturer in the world now either uses that particular display condition when reporting data, or a very closely related 500 lux for 10 hours per day. The one exception is Kodak, which is using an illumination level of 120 lux extrapolated to 12 hours per day.

If our research group and the product testers at Epson, Canon or Hewlett Packard used the same illumination levels that Kodak uses to report their display permanence data, you could multiply all our numbers by a factor of roughly 3.75. For instance, the HP product that we've rated to last 73 years would last 270 years under Kodak's test conditions.

What this means is that when Kodak advertises that their Generations or Endura photo-printing papers can be displayed for 100 years before noticeable fading, the consumer naturally concludes that photographs processed on those papers are more light stable than Epson's pigment prints or HP prints, when in fact the opposite is true. Kodak's data is in no way comparable to what everyone else is reporting.

**WORK:** It's also not realistic. It's hard to see a print at 120 lux.

**WILHELM:** It also doesn't deal with the significant part of the display print population that is displayed at much higher light levels. So clearly there is the need for standardized tests. We, and many other people in the industry, are working to develop ISO test-method standards that we hope will end that kind of confusion.

**WORK:** Or at least make it clear that other folks are playing by different rules.

**WILHELM:** Right. It gets back to the analogy of automobile gas

mileage tests. It wouldn't be hard to even double or triple your gas-mileage rating if you were very, very careful in the design of the test.

**WORK:** How much has inkjet product testing evolved over the past three to five years? What important lessons have been learned?

**WILHELM:** Ray, as you know this isn't a perfect science. We are all learning as the field moves forward. And, you can find examples of this throughout the history of color photography: New technology can produce entirely new modes of image deterioration. For example, using "instant-dry" microporous papers with



Will the image you print today still look as good 25 years from now?



dye-based inks produced a system that was more sensitive to ozone than anything we have seen in the history of photography.

When the ozone problem first occurred, the reasons for the problem weren't well understood. Our company was very much caught up in that, because we had provided the light-stability data to Epson that led consumers to believe that prints displayed under glass would last 9 to 10 years before noticeable fading would occur (at 450 lux for 12 hours a day). When consumers started experiencing catastrophic changes in less than a week, that was a major problem. At first, we, nor anyone in the industry, didn't understand what was happening or why.

Another important lesson I have learned is that not many consumers display all of their traditional photos under glass. Nor can we expect consumers to take a lux meter and measure the optimal location in their homes to display their valuable photo. People will put prints where they want to, and we must be able to develop prints that can tolerate a range of display conditions.

Which brings me back to the need for standardized test methods. Epson's new R-300 photo printer uses a new dye-based ink that has improved light stability and greater resistance to ozone even on the existing microporous papers.

But how big an improvement is it? You must have standardized ozone-exposure test methods to be able to answer that question. People will also want to know how this improved product compares to polymer-type papers, pigment prints, laminated prints, or even photographs output on Fuji Crystal Archive photo paper. If you don't have an accepted, universally applied test method and consistency in reporting the data, then the whole thing can be of limited usefulness.

**WORK:** What advice would you give to buyers of inkjet printers who read various claims related to inks and media. What should they be paying attention to?

**WILHELM:** First of all, is there any permanence data available at all? At some level, everyone taking photographs is concerned about image permanence or they wouldn't be taking pictures in the first place.

Generally speaking, staying with the premium products of each printer manufacturer would be initial good advice. One major problem with third-party brands is that they're trying to design inkjet papers for all printers and ink systems, or the lowest common denominator. The downside is that those papers aren't optimized for any of them—not just in terms of image permanence, but in terms of ease of drying and other properties.

Right now, at the consumer end of things, most developers of third-party inks and papers are paying little or no attention to image-permanence issues. For example, there is a combination of HP inks and media that we rated as lasting 73 years. This life span fell to just two years when the consumer substituted a Staples-branded photo paper for the HP premium photo paper.

And it's rapidly becoming more even more insidious. Companies such as Office Depot and Office Max are launching their

own house-branded inks, which may not last nearly as long as the printer manufacturer's product. An extreme example is a third-party ink being sold for an Epson printer. Depending on the type of Epson media used, prints produced with Epson printers and pigmented inks were rated at 70 to 100 years. Some of the third-party inks we tested took those numbers down to less than six months, because the third-party ink suppliers were substituting low-stability dye-based inks for Epson's high-stability pigment inks and implying that the inks were suitable for photography. It's almost fraudulent.

**WORK:** From my experience, the reason stores are putting out their own brands is simply to provide their customers with a lower-priced alternative. But when they purchase lower-cost supplies to sell to their customers, they don't really understand the criteria for sourcing quality products. I believe that as time goes by—after these big stores get their fingers burned a few times by consumer complaints—they'll find suppliers that offer them good, well-tested technology at a lower price.

**WILHELM:** I have devoted my entire life to the preservation of photography. And when I see some of these third-party inksets, I am really deeply distressed.

More than half the testing our company does is funded internally—not by product manufacturers, but internally. We test selected third-party inks and papers to provide a more comprehensive view of what consumers can expect from different products on the market.

What we hope to get out of it is a more educated consumer. An important part of my work is to provide a framework to stimulate competition. I think competition is extremely important.

**WORK:** We need independent third parties who are capable of pointing out deficiencies and needs for improvement in a constructive way. The goal isn't to pick on people, but rather to move the entire industry forward in terms of quality, longevity, and overall customer satisfaction. ☺

*Henry Wilhelm and Dr. Ray Work are members of PDIA's Advisory Team. PDIA members can find additional excerpts from their dialogue on trends in inks and media in future issues of Great Output and in the members-only portion of the PDIA's website: [www.greatoutput.com](http://www.greatoutput.com).*



Wilhelm



Work

*For more information on Wilhelm Imaging Research visit [www.wilhelm-research.com](http://www.wilhelm-research.com). For information about Dr. Work, visit [www.workassoc.com](http://www.workassoc.com)*

# GREAT 8 OUTPUT

02.2004



THE OFFICIAL PUBLICATION OF THE PROFESSIONAL DIGITAL IMAGING ASSOCIATION

## THE ART of Inkjet Printing

Henry Wilhelm on  
Image Permanence

A Primer on  
Protective Clearcoats

RIP software: RIP-off  
or Money Saver?





## what's new at PDIA

G E N E L A M B E R T  
E X E C U T I V E D I R E C T O R

### At Your Service

The Professional Digital Imaging Association (PDIA) is a new organization that can connect you with the specific information you need to achieve the best results in digitally printing your images. In our members-only website, future issues of this magazine, and in our *Great Output* Seminar Series, you'll find practical advice for digitally outputting, finishing and displaying your images.

**Great Output magazine:** Those of you who aren't yet PDIA members are receiving this premiere issue of *Great Output* magazine because we want to show you the type of quality information that our first-class team of digital-printing experts will deliver. In 2004, PDIA members will receive additional issues of *Great Output* in May, August and October. We'll also publish reference guides, training CDs, and other information resources.

**Great Output seminars:** The first course in PDIA's *Great Output* Seminar Series is "Maximizing Profits in the Digital Darkroom" and will help professional photographers who have begun using inkjet printers to output their own photographs. Visit [www.greatoutput.com](http://www.greatoutput.com) for the complete course outline and details on when this seminar will be presented in a city in your area.

**Great Discounts for Members:** The annual PDIA membership dues of \$99 for individual members can easily be recovered through the many discounts we'll offer you throughout the year. PDIA members can take advantage of discounts on car rentals from Alamo and Budget, stock photography from PhotoSpin, health and benefits programs for individuals and your employees, and a vast array of media-technology books.

Education and knowledge are at the very heart of our mission. Our network of members, partners and sponsors create an expertise pool that will deliver the knowledge you need when you need it. Our exclusive focus on digital printing allows us to leverage 100% of our effort toward your unique printing requirements. If you aren't yet a PDIA member, we invite you to visit [www.greatoutput.com](http://www.greatoutput.com) and sign up today. Then, tell us what help you need and we will deliver it. We work for you!

All my best,

Gene Lambert  
Executive Director and Publisher  
[gene@greatoutput.com](mailto:gene@greatoutput.com)

The PDIA thanks our sponsors for generously supporting our efforts to bring you quality information:

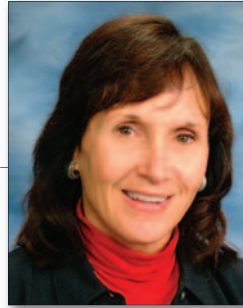


#### ADVISORY TEAM:

Elizabeth Cunningham  
Bernard Girma • Henry Wilhelm  
Ray Work • Kevin Vesely



# noteworthy



EILEEN FRITSCH  
EDITOR

## You're Not All Alone in Wonderland

If you sometimes wonder if you're the only one baffled by the sometimes surreal progression of questions about digital printing, rest assured. You're not alone.

Digital-printing products are often rushed to market with minimal documentation and little foresight into what real-world problems the newest "solution" might create elsewhere in your digital workflow. It can all be extremely maddening—particularly when good information is scattered throughout so many different sources.

At *Great Output*, we'll address many of your concerns. The contents of this issue are based on conversations I've had with many digital printing novices. In future issues, we'll answer the questions you send us.

We are gratified to have the support of some of the best-informed individuals in digital printing. In this issue, you'll find articles by Harald Johnson, who wrote the book on "Mastering Digital Printing," and color-management whiz Roy Bohnen, who has personally used nearly all of the most popular software RIPs on the market. You'll also enjoy the conversation between Dr. Ray Work (one of the pioneers in developing inks for inkjet printers) and image-permanence expert Henry Wilhelm of Wilhelm Imaging Research.

You are receiving *Great Output* because we believe you may be interested in learning more about digital printing. Future issues will be sent exclusively to members of the PDIA. So if you like what you read in this magazine, please visit [www.greatoutput.com](http://www.greatoutput.com), join the PDIA, and tell us what questions you'd like to see addressed in our May, August and October issues.

Together, we'll find the answers!

Eileen Fritsch, Editor  
[eileen@greatoutput.com](mailto:eileen@greatoutput.com)

VOLUME ONE • NUMBER ONE • WWW.GREATOUTPUT.COM

# GREAT OUTPUT

THE OFFICIAL PUBLICATION OF THE PROFESSIONAL DIGITAL IMAGING ASSOCIATION

PUBLISHER  
EDITOR  
CREATIVE DIRECTOR

PDIA MEMBERSHIP  
GREAT OUTPUT SEMINARS

INFORMATION

Gene Lambert  
Eileen Fritsch  
Ted LoCascio  
Ashley Wood  
Tom Gruss

888-873-7553

All contents ©Copyright 2004 Professional Digital Imaging Association. All rights reserved. Any use of the contents of this publication without the express written consent of the publisher is strictly prohibited. All trademarks mentioned belong to their respective owners. Some of the views expressed by contributors may not be representative of the views of the publisher.

### in focus

6

**Products, ideas, and innovations**  
for photographers and artists seeking to  
sell digital prints.



Page 7

### features

10

**The Myths and Realities of Inkjet Printing**  
Harald Johnson examines the validity of popular  
myths about inkjet print resolution, printmaking,  
printing supplies, and digital printing's place in the  
world of fine art and photo reproduction.

16

**Will My Prints Last As Long  
as Traditional Photos?**  
Inkjet ink pioneer Dr. Ray Work interviews Henry  
Wilhelm, of Wilhelm Imaging Research about new  
developments in testing materials used in inkjet  
photo reproduction.



Page 12

20

**RIP Software: A RIP-Off or Money Saver?**  
Color-management pro Roy Bohnen answers basic  
questions about RIPs and reviews some of the major  
differences among products for the reproduction and  
proofing of photos.

### columns

28

**Media Savvy**  
Deciphering Spec  
Sheets for Art Papers

30

**Finishing Up**  
A Primer on Protective  
Clearcoats and Varnishes

34

**That's a Good Question**  
Answers to the Digital Printing  
Questions that Puzzle You Most

### on the cover



**The new  
Epson Stylus  
Pro 4000**

outputs an  
image that  
was digitally  
captured by  
Vancouver,  
WA-based  
photographer  
Jeff Dorgay.  
Cover design by  
Ted LoCascio.



# INFOCUS

news • opinions • products • inspiration • innovation • trends

## Shedding Light on Longevity Claims

THE FINE PRINT CAN FOUL UP YOUR PROFIT PICTURE

The art lover who shells out big bucks for your inkjet-printed work will presume that it will remain looking good whether he hangs it in an office or above the living-room sofa. If the print fades prematurely, the aggravated print buyer will probably demand some sort of restitution—either in the form of a refund or a new print. Lawyers call this the “implied warranty of merchantability.”

Many digital printmakers have learned about this implied warranty the hard way—by suffering the embarrassing and costly consequences of using the

wrong digital printing materials for the job. The artist writing the refund check either placed too much faith in product-marketing claims or simply hadn't done sufficient homework to choose the right print materials and finishing techniques for the surroundings in which the print would be hung.

Although great strides have been made in inkjet materials-testing methodology, industry-wide test standards are still in the development phase. In other words: There are no standards.

Understanding how your inkjet materials were tested can pay off because your prints can fade faster than the manufacturer claims if your prints will be hung in places where the lighting will be substantially different from the lighting conditions in which the materials were tested.

Bottom line: The test methods that printer manufacturers use to estimate how long a digital photo print will look good hanging on a refrigerator door or office cubicle may not be entirely accurate in estimating how long a fine-art print will last when displayed over a sofa in living room with lots of windows.

On pages 16-19, Henry Wilhelm of Wilhelm Imaging Research explains what it means when a printer manufacturer says a certain type of media has been Wilhelm-tested to last a certain number of years. In the next issue, we'll look at alternatives to Wilhelm's test methods and some of the key differences between the test standards being developed by committees of the ISO and ASTM.

The primary difference is that the ISO test standards are evolving from methods originally developed to test conventional photographs. The ASTM test standards are being developed by the same committee that wrote the test standards for oil paints, watercolors, pastels, colored pencils and other traditional fine-art materials.



Different Companies Use Different Test Methods: In some of the same Rochester, NY facilities used to test the consistency of their traditional imaging papers and films, Kodak tests how their inkjet media will perform with different types of inkjet printer and ink combinations. Shown here are tests being conducted for Kodak's wide-format inkjet media.