

Inkjet Prints and ASTM Testing by Mark Gottsegen

Making art using the latest inkjet printing equipment and inks has rapidly become a dominant and pervasive form of artistic expression.

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Introduction

This article is an attempt to address the multitudes of attitudes that have developed over the last six years regarding the use, longevity, and testing of inkjet inks. The first section briefly introduces those products and why it's important to think about them as art materials. The second section provides an overview of American Society for Testing and Materials International's [ASTM] art materials standards-writing activities compared to those of the International Standards Organization. The last portion of the article discusses the testing of inkjet products, proposes reasons why current methods will not satisfy artists, and how ASTM's methods will work.

1.

1.1 Making art using the latest inkjet printing equipment and inks has rapidly become a dominant and pervasive form of artistic expression. This phenomenon has been driven by intense marketing by the major manufacturers of the products, directed mainly at the mass-market (consumer) users. Artists have adopted the technology, partly because it has heretofore been relatively inexpensive — compared to, say, the traditional canvas/paint/brush applications — and partly because it is so closely related to the technology of photography. The consumer perceives photography to be “easy.”

1.2 Although I am a painter, I am involved with the digital revolution. I use a digital camera to document my paintings and drawings; I use computer software to make color corrections in my digital photographs; and, I teach in an art school where digital art is part of the design program and has the most number of majors, compared to all the other programs. Therefore, I have had to become familiar with all of the software and hardware associated with the form.

1.3 Moreover, my responsibilities as chair of the ASTM International subcommittee D01.57, which writes standards for art materials, include the development of new standards. Inkjet printing is positively ripe for a standard.

1.4 There are no standards for inkjet prints, or any art material associated with them. There are not even any standardized definitions of the terms associated with these materials. I am a member of a Yahoo discussion group that addresses these issues (<digital-fineart@yahogroups.com>), and even participated in the writing of a Glossary of terms (<<http://www.dpandi.com/DAPTTF/index.html>>). This Glossary is as close to a standard as I have seen, but since it's not well known a lot of people use various terms for the art in non-standard way.

2.

2.1 Before continuing with the problems of inkjet products, it seems like a good idea to give a little background to the development of standards. So the next question is, “What is a standard?” Many people, artists included, erroneously assume that a standard “makes all things the same,” with regard to a standardized item. That is, a standardized ballpoint pen means that all ballpoint pens are alike. That is obviously not true. In the same way, a “standardized art material” does not mean that all terms or art materials included in the standard are alike, in performance or even appearance.

2.2 A good example of this is artists' oil paints. Since there has been an ASTM Standard for these paints since the early 1980s, there is plenty of opportunity to look at the marketplace to see examples of these products. There are a large variety of textures and color ranges among brands, and within the same generic color name (say, “burnt sienna”) there can be marked variations of hue. There are literally dozens of brands of oil paints marketed to artists and many meet the ASTM Standard D 4302 for oil, resin-oil, and alkyd paints, although most also do not advertise that fact. How do they meet the Standard? By labeling in conformance with it.

2.3 What are the requirements of this ASTM D 4302 Standard? The answer is pretty simple: Disclose on the product label or in company literature the following facts: the generic name of the colorant (pigment), the Colour Index Name of the colorant (say, “PY 42”), the vehicle contents (“Alkali-refined linseed oil”), and the Lightfastness rating of the colorant (“LF I” or “LF II,” or some terminology similar to that). Using these terms on a product label allows the manufacturer to claim that the product “Conforms to ASTM D 4302.” If you go to an art supply store, you will find many — most — oil paints using the terminology. It's remarkable that this has occurred in the last twenty-five years, and the subtle influence and pervasiveness of ASTM standards is responsible.

2.4 As I already said, there are no standards for printed inkjet media. There is an ongoing effort to establish some standards within the International Standards Organization (ISO), but this group has so far been unsuccessful. The

reasons for their failure over the last 25 years of trying are complicated but can be summarized with two words: "commerce" and "politics." In the ISO's Working Groups, manufacturers of products ("commerce") dominate the proceedings. Since each company has a vested self-interest in the outcome of any proposed standard, and since there is no acceptable contribution from consumers or other disinterested third parties, consensus agreement seems bound to fail. And politically, the ISO's operational system finally allows only one vote from each participating country. The political and commercial impediments notwithstanding, the next question is, "Is there a technical reason why there are no standards for inkjet media?"

2.5 The technical reasons for the ISO's failure are manifold. I have witnessed the discussions in ISO meetings, and can offer an opinion about the technical process. In the first and most fundamental sense, the members of the ISO Working Group on these products can't agree on what to test and write a standard for. Since it is well recognized that there are about 11 conditions that jeopardize the durability of these materials (light, ozone gas, dark fading, reciprocity, humidity, and so on), they are trying to deal with all of them. Each little subgroup that works on a single issue even has trouble producing a test method or document satisfying to the entire subgroup, let alone the larger Working Group. Finally, if you aren't at the meetings your participation does not count: I am not allowed to participate and no longer receive Minutes because I cannot attend the meetings.

2.6 In contrast, ASTM International's process seems much simpler — and here I admit my bias towards it, even as you already assumed I would have one. In each subcommittee responsible for a set of standards, ASTM balances the voting membership among manufacturers ("Producers") and other "Users"; technical experts (including scientists) and consumers (also called "Users"); in all subcommittees ASTM tries to ensure that a User chairs the subcommittee. In addition, disinterested third parties can participate. In ASTM International, meetings and participation is completely open — there is no registration fee, and any party interested in the proceedings can join to contribute or even just observe. However, to have a vote you must be a paid member of ASTM International. Finally, attendance at meetings is not required for participation — a member can participate in discussions and conduct ASTM business via email and the Internet.

2.7 ASTM's approach to the durability of art materials is also distinguished by its simplicity. First, we long ago decided not to attempt to define what an art material is, and whether to worry about non-art materials or lower quality art materials. The consumer users and manufacturers agreed in the late 1970s that high quality art materials would be addressed by the standards ASTM D01.57 produced, and that lesser quality materials would exclude themselves.

2.8 Second, we recognized that the reasons for the failure of an art material or a product made with them ("art") were far too complex to be addressed in minimum performance and quality standards. Even a very high quality product can be misused, or exposed to conditions beyond the control of the artist or the manufacturer. We therefore decided that the only conditions art would be exposed to would be the average indoor environment. That is, if we wrote a standard for a product, we would aim for its durability under those conditions: incandescent lighting, daylight through window glass including some ultraviolet light, and moderately stable temperature and relative humidity. These conditions were picked because we know that most art is exposed in homes and businesses, not in museums or galleries.

2.9 Finally, we also decided that the first and most significant failure that people would notice in a work of art is the loss of or change in color. That is, lightfastness — the ability of a material to resist change when exposed to light — is the fundamental attribute of an art material that we should deal with. With that in mind, ASTM D01.57 wrote, over a number of years, ASTM D 4303, "Standard Test Methods for Lightfastness of Colorants Used in Art Materials."

2.10 The principal investigators who did the research for ASTM D 4303, led by Joy Turner Luke with Henry Levison (Liquitex paints) and Robert L. Feller (a well-known conservation scientist), tested hundreds of oil and acrylic dispersion paints under a large variety of lighting and environmental conditions — from making paints that were applied to car fenders and exposed to south Florida weather, to producing laboratory-controlled applications and accelerated exposures in various xenon and fluorescent instruments. As time passed and data accumulated, it became easier to have confidence in the results of controlled accelerated testing so that it was possible to write a standard that all the D01.57 participants (about 45 people), and ultimately the entire ASTM society (some 30,000 members) could agree upon. (Supporting data are available from www.astm.org. Request Research Report D01-1036.)

2.11 Since its first publication in 1983, D 4303 has undergone some minor revisions and two major overhauls. Its current version was published in July 2006. A summary of the methods is that art material samples are specially prepared for testing and exposed under at least two of four possible conditions: to daylight, outdoors under glass in Arizona (dry) or Florida (humid), and to simulated daylight in a filtered xenon lamp exposure instrument with or without humidity added. All conditions are monitored to ensure appropriate exposure to a standard amount of light that includes UV and IR, to simulate the exposure the art material would endure if displayed indoors under glass. Test specimens are measured before and after exposure, and the color differences are calculated. Depending on the results, the colorants can be placed in a number of categories of lightfastness, of which only two are of interest to artists: Lightfastness I and Lightfastness II.

2.12 ASTM D 4303 does not predict how long an art material will last, or even how long the colorants used in the materials will last – no test can predict that. It only establishes categories of lightfastness that are recognizable to artists and useful to them, and to the manufacturers of products that use them. The standard does provide a basis for developing specifications for art materials such as ASTM D 4302. In that regard, D 4303 has been used successfully to produce specifications for artists' acrylic dispersion paints, transparent and opaque watercolors – the major art materials used by artists -- and colored pencils, also a well recognized art material. In addition, D01.57 is nearing a ballot on a specification for pastels, another well-recognized paint.

3.

3.1 Now that I have compared the ISO and ASTM standards-writing procedures it is time to take a look at the inkjet materials, for which there are no standards. Why are there no standards for these materials, other than that the ISO can't seem to write one? The answer could be embodied in a comment made by one of the contributors to the Yahoo D-FA group: The manufacturers would prefer not to have a standard, since they could then continue their marketing efforts uninhibited by scientific scrutiny.

3.2 From a marketing perspective, this answer certainly seems reasonable. "Scrutiny" might invite an unbiased comparison of one product with another, resulting in a rank ordering along the lines of "This product is good, and that one is bad." What marketing person would want to take the chance that her product is the one ranked "bad"? In addition, the marketing people have already made it clear that they are aiming for the consumer market, where standards of the kind I have discussed are seen as unnecessary.

3.3 My conversations with manufacturers' scientists on this point offer a different perspective. They actually would not mind a standard for an artist's version of their products: they recognize that, as in the art materials world, their companies could offer two tiers of products – the cheaper versions for consumers who do not care about standards, and a more expensive version aimed at the artist's market. But as those in the art materials industry know well, marketing has an unfortunate tendency to drive science.

3.4 One impediment seems to stand in the way of manufacturer commitment to real standards – their already established commitment to the ISO effort: They've been wrangling in the ISO arena for so long, they can't give it up. But this is a red herring: No one suggests that the ISO effort be scrapped. But I do suggest that an ASTM International standard be developed in addition, and that it be for artists' materials.

3.5 Another impediment could be that inkjet ink and printer marketers can claim they are already submitting the products to scrutiny – to the tests of Wilhelm Imaging Research (<<http://www.wilhelm-research.com/>>), for instance, which provides the industry with predictions of longevity based on a proprietary test method developed by Henry Wilhelm and his colleagues.

3.6 We have to recognize, however, that Mr. Wilhelm, a well-known expert in the photographic materials industry, is operating a commercial enterprise – as do others who might in the future provide similar services – and so relies on the industry to fund his work. To be even more blunt, however: If your local TV station's meteorologist can't accurately predict this afternoon's weather, how can someone predict that X company's digital ink is going to last 203 years in specified conditions? The two major companies in the business of materials testing (Atlas Materials Testing Solutions, <<http://www.atlas-mts.com/>> and Q-Lab Corporation, <<http://www.q-panel.com/>>) do not ordinarily offer "service life predictions," so how can Mr. Wilhelm? This question remains unaddressed after six years of trying to find a reasonable answer.

3.7 Another possible stumbling block: The artists who use the inkjet products might themselves be an impediment to the development of a standard. So far, in my three years of participation in the Yahoo group, I have been faced nearly continually by the expression of almost willful ignorance on the part of those members, along the lines of: "I don't want to know this stuff because I don't have to." This is in addition to the usual artists' expressions of distrust of the industry, their desire to use the cheapest products in order to increase profits, their claims that ASTM standards apply only to paints and that their special materials can't be addressed in the same way, and so on: all old news to someone who's faced artists like these in academia and in the world of ASTM International. (Strangely, for all our purported political and social radicalism we artists seem to be as conservative and resistant to change as anyone.)

3.8 All of these "impediments" will disappear if we want them to; we just have to have the will to make it happen.

4.

4.1 In this section, I am going to lay out the technical problems ASTM D01.57 faces in working out a standard for inkjet materials – I am not going to address the human problems.

4.2 Let's assume for a moment that it will be possible to gather together in one room a single manufacturer/distributor of inkjet printers/inks/papers represented by a scientist from the company (and maybe backed

up by a non-voting marketing person), a single artist who uses the products, and a couple of interested third parties — say, a color scientist, perhaps an art conservator, a conservation scientist, maybe a reporter, other kinds of artists, and so on. We can assume that when this gathering occurs we will have already decided that it's worth exploring the writing of a standard. A few other things will have to be decided before things can happen.

4.3 First, the participants will have to decide whether ASTM D 4303 is a reasonable basis for a standard. It's been amply shown already that the methods work for other materials — materials as sensitive to environmental conditions as the inkjet materials — so using D 4303 seems reasonable.

4.4 Second, the group will probably have to decide whether to make this colorant-based standard specification like many of D.01.57's other standards, or a product-based standard like D 6901 for colored pencils. This is entirely reasonable, too, since ASTM D01.57 has long since passed the point of dealing only with traditional artists' paints. Once we enter an area where the consequences of using a "non-traditional" binder about which little is known and which is likely to come in a variety of formulas, it's far better to develop a standard based on already-manufactured-product testing.

4.5 The next question is "Since we are testing these products for lightfastness, how will we prepare samples?" The answer to this question is more complex, and will require some testing to arrive at a conclusion agreeable to all parties. One of the requirements of D 4303 testing is that samples be made on a stable generic substrate, "at complete hiding" (this is ASTM-ese for "opaque"). In the first place, inkjet inks — even if pigmented — are inherently transparent; that's how color mixtures in the prints are made; the probable solution to this problem will be to specify the application of an even film laid down by a single printer for all the tests. Naturally, there will be considerable debate over which inks and printer will be best for this preparation.

4.6 In the second place, there is no generic substrate amenable to all forms of inkjet printing: a lot of companies achieve their most durable products by combining inks specially formulated to work with a specifically formulated coated or imbued paper or fabric. There also will be lots of debate about which substrate to use, but eventually a consensus will be reached.

4.7 Finally, we will reach the stage where some round robin testing will occur. Round-robin testing, wherein a minimum of three laboratories conduct tests on duplicate samples of the same products all at the same time, is necessary in order to develop data to show that the test method is repeatable and reproducible. This is a required feature of ASTM standards, reported in the Precision and Bias section of each document, and it assures the user of the standard that sufficient consideration has been given to the process to ensure reliability and confidence in results.

4.8 At last we will reach the point where a standard can take shape. Since we already have a model in D 6901 this stage will easily be completed — and the standard can proceed to ASTM balloting. For a new standard such as this, the balloting process requires first a ballot within D01.57. If that ballot passes with no negative votes (a single negative will stop the process until it's resolved), it can proceed to simultaneous balloting in D01 (the Main Committee) and ASTM (the entire Society gets to look at the standard and vote on it). Experience shows that once an item passes subcommittee and Main Committee balloting, the standard will likely get published.

4.9 That will not be the end, however. A unique feature of ASTM International standards is that they're required to be reviewed and re-approved every five years. Five years in the inkjet ink and printer business is a very long time — the technology is advancing at a pace similar to that of the computer world — it's probable that a new standard for these products will undergo revision and updating sooner than the required five-year mandatory review.

5.

5.1 I understand that this article has been a long hard read, and that it contains speculation and opinion that could differ from a reader's point of view. I therefore invite your response.

I gratefully acknowledge the editorial contributions of Joy Turner Luke. Any errors of fact, however, are solely my responsibility.

Mark Gottsegen

Addendum, based on a question

On the Digital Fine Art Yahoo Group, someone posed the question, "how do we provide economic incentives that will really encourage this kind of project, and get it going?" That's a good question, and here's the answer:

The "economic incentive" is built into the process and the outcome. The first company that announces conformance with

an unbiased, peer-reviewed, third-party standard gets to trumpet that fact to the world -- and thereby increase its sales to artists who want this kind of assurance of quality. The artist market is much smaller than the consumer market, but it's there.

And it's happened, too. The first company to market a lightfast set of colored pencils was immediately bought out by a big Japanese company who made hay for a year. A second company, English, followed suit. A third company, American, and the one whose initial comment was "We make the best colored pencils on the planet and we don't need a standard," jumped in, finally, too.

So now, colored pencil artists have three companies whose products conform to ASTM D 6901 and those artists who want to use lightfast colored pencils, which are in limited sets and are more expensive than the other cheap junk, can do so.

What a great thing that would be for the inkjet printing ink/paper/printer industry, and its artists, don't you think?

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