Article: Report on ANSI Standard IT9.9: Stability of Color Photographic Images—Methods for Measuring
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Report on ANSI Standard IT9.9: Stability of Color Photographic Images—Methods for Measuring

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The American National Standards Institute, or ANSI, is the official standardizing body of the United States. A federation of 900 companies and 200 trade, technical, professional and consumer organizations, ANSI serves as a clearinghouse for nationally coordinated voluntary standards. There are about 10,000 approved ANSI standards, dealing with dimensions, ratings, terminology, symbols, test methods, and performance and safety specifications for equipment, components, and products, in fields ranging from building construction, to information technology, to laboratory testing.

Standards are vital because they provide a consensus of pertinent disciplines, resolve differences of opinion, and in the case of the photographic standards, influence manufacturers and others to improve products and storage conditions in attempts to meet the standards.

Among the ANSI-accredited standard developer organizations that is NAPM, the National Association of Photographic Manufacturers, Inc. NAPM is the governing body for NAPM Technical Committee IT9, whose scope is to write standards for physical properties and permanence of imaging materials. Chaired by Dr. Peter Adelstein and including technical experts from the US, Canada, Germany, France, the UK, and Japan, members of IT9 and its four subcommittees meet two times a year to handle 25 standards, including IT9.2 on Filing Enclosures, IT9.16 the Photographic Activity Test, IT9.18 on Plate Storage, and IT9.20 on Print Storage. Several of these are in the process of being revised, reviewed or approved at any given time. Contact with NAPM and ANSI in general is handled by the IT9 secretariat, John Gignac.

Although technical committees in standards development may receive private and government support, it is usually the manufacturers who do the lab work to verify information before it can go into the text of a standard. This work is done in the interest of financial return and the improved use of their product. In the case of image permanence standards, both the Image Permanence Institute and Wilhelm Imaging

Research have also made significant test data available to the IT9 subcommittees.

Steps to create a standard:

On a 5-year cycle, all standards come up for review and undergo either a reaffirmation in their existing form, or are revised and approved, or submitted for withdrawal. In addition, either through research or general knowledge of the field among members of the committee or a subcommittee, the need for a new standard may be realized. When this results in the development of a standard, the procedure is as follows.

An project leader or task force begins with a body of research and a draft of the new document. If the subject matter is appropriate for one of the subcommittees, it is handled there during subsequent document drafting stages; in a few cases it is handled by the full technical committee. The draft is discussed during full-day sessions at the semi-annual meetings, and further research may be required if it is deemed necessary to confirm any part of the proposed standard, and drafts are continuously revised until a final draft is agreed on.

The draft approved in subcommittee then goes to the full technical committee for review and letter-ballot approval. Often points of consistency with other standards or general vocabulary are hashed out by the full committee, along with technical issues identified in ballot comments. Once all comments have been resolved and editorial errors corrected, the IT9 secretariat initiates a ballot to the NAPM Standards Advisory Committee, or SAC.

SAC is the oversight body responsible for the administration of standards development within NAPM. The process of review by SAC consists of a 30-day mail ballot in which members vote not on the standard's technical content but instead consider voting results, ballot comments and their disposition, and the procedure that has been followed, in order to assure that due process has been conducted.

SAC review can occur simultaneously with ANSI public review. For this step, the secretariat sends required documentation to ANSI, requesting a 60-day notification period of public review be initiated. Thereupon, data on the proposed standard will be published in the next issue of the publication ANSI Standards Action, which lists all documents currently in the review process and also tabulates those that have been withdrawn, approved, reaffirmed, or revised.

Sixty days after publication in ANSI Standards Action, the standard is eligible for final ANSI approval if there are no public review comments to address. ANSI approval is made by the ANSI/BSR, or Board of Standards Review. The secretariat submits to the Board a tabulation of the final vote on the proposed standard, including a breakout by member type such as producer, user/consumer or general interest, a letter-ballot tally sheet that documents the vote of each respondent; and a roster that identifies technical committee members and their classification. The Board ballots on this information in order to again establish due process. This final step in the approval process is typically 5-8 weeks before the standard is official,...... until five years later when it must be reviewed again.

Subcommittees:

While members of the full committee participate as representatives of companies, institutions and organizations, subcommittees are made up of technical experts who are there to represent their individual expertise, not the organization or institution for which they work. There are five subcommittees under NAPM Technical Committee IT9; IT9-1 handles Silver Image Stability, IT9-2 handles Black-and-White Paper Stability, IT9-3 handles Color Materials Stability, including digital output (generally called hard copy), and IT9-5 handles other materials in the new field of Electronic Imaging, particularly magnetic and optical materials.

Subcommittee IT9-4, Dry Silver, is currently inactive. Its prior activity involved computer output microfilm (or COM) products and resulted in a standard in 1994 for Stability of Thermally Processed Microfilm, designated ANSI/NAPM IT9.19-1994.

Currently the Silver and Paper subcommittees are working on IT9.25, a photographic paper standard. The Silver subcommittee has contributed recommendations for residual hypo and residual silver, which will be incorporated in the text that will be prepared by the Paper subcommittee. As of the Spring 1996 meeting, the Silver subcommittee has now also become temporarily inactive.

IT9-3, the Color subcommittee, was formed in 1978 in response to a paper given by Henry Wilhelm at the May 1978 meeting of the SPSE, now known as IS&T. Henry's paper, called "Light Fading Characteristics of Reflection Color Print Materials" was the first disclosure of the phenomenon of reciprocity failure in accelerated aging tests, and because of it, Klaus Hendriks, of the National Archives of Canada and organizer of the meeting, suggested to ANSI that a special committee be formed to address the problem and write a standard for dark and light stability testing of color materials. The first meeting of IT9-3 was in December of 1978, at the National Geographic Society, and for 12 years members toiled to produce the first version of IT9.9, finally approved in 1990. Work never stopped even after publication of this standard, and IT9-3 and the full technical committee IT9 recently approved and sent to SAC Process Review IT9.9-1996, which I will describe in some detail in a few minutes.

During the past two years, many new members involved with digital color hard copy have joined and become very active with the group. During our April meeting, most of time was devoted to color hard copy and to determining the special requirements for a specification for color hard copy which might not apply to photographic materials. A special task force was set up to investigate the even more particular requirements needed to create a standard for the outdoor weathering of color hard copy materials designed for outdoor use. This group is currently collecting and evaluating samples, investigating properties, and researching and writing suggested test methods.

Subcommittee IT9-5, the Electronic Imaging subcommittee, meets apart from the general meetings of IT9 due to the nature of their work, member composition, and geography. Although this committee is still meeting and has produced two documents in the last year, the test method for the life expectancy of CD-ROMs (IT9.21) and the document on the storage of magnetic tape (IT9.23), work on a standard for the handling of magnetic tape has stopped due to non-participation of the manufacturers. With no labs to run tests, the standard is in hiatus. The reason there is no incentive to work on this standard on the part of the manufacturers is that they are being asked to test a property of their own product which is a weakness of the product; namely, the life expectancy of the magnetic tape. Some manufacturers believe that there is no reason for the magnetic tape to outlive the mechanical equipment for the technology it is used for, and that it is more important to be able to transfer or migrate data off of obsolete diskettes and tapes than to preserve the tapes for the future. There are many people in the preservation field, however, who do not agree with the idea that long-term preservation of original tapes—especially audio and video tapes—is important.

IT9.9-1996:

Recently approved by the full IT9 committee as NAPM IT9.9-1996, the proposed American National Standard for Imaging Materials—Stability of Color Photographic Images—Methods for Measuring. On its approval by the ANSI Board, IT9.9-1996 will provide a set of procedures for testing the light-fading and dark-storage stability characteristics of color photographs. This standard does not cover digital hard copy materials.

IT9.9-1996 is a revision of NAPM IT9.9-1990, and has taken several years of intensive work by the color subcommittee to complete final text and approval. The standard addresses, (one), general test practices that are necessary in order to maintain consistent conditions and achieve meaningful data, and, (two), situations or characteristics of test procedures or specimens which might result in anomalies in the data, and possible solutions to these problems.

Before the text of the standard itself, the publication includes a 3-page Foreword which, although not technically a part of the standard, includes some very important explanations which I will be referring to in this paper.

The standard opens with an Introduction which describes the standard in general terms. The scope of the standard is the description of test equipment and procedures for determining light and dark stability of color photographic images. (I should mention that we are very specific in our selection of descriptive designations, and we struggle long and hard when deciding between such phrases as photographic materials, imaging materials, photographic images, etc., because we have to be sure that we are designating a specific standard or procedure for its intended application.)

The tests in the standard evaluate stability of color materials by accelerating the aging process and then analyzing the results, so the next thing the standard does is explain the basis for which tests and analytical procedures were chosen; what relationship has been established between (one) the test, which accelerates the aging process, and (two) normal storage conditions under which the photographs age in real time, and what might be the limitations.

The dark stability test is an adaptation of the Arrhenius method, which has proven applicability to real-time dark fading and yellowish staining with a few known exceptions, and so the standard reads: "Although this method is derived from well-understood and proven theoretical precepts of chemistry, the validity of its application to predicting changes of photographic images rests on empirical confirmation. Although many chromogenic-type color products yield image fading and staining data in both accelerated and non-accelerated dark aging tests that are in good agreement with the Arrhenius relationship, some other types of products do not."

You notice the qualification of the applicability of the test, and further the change in designation from "color photographic images" to "chromogenic-type color." The standard, along with being accurate in its description of the test methods, must also be very clear and specific about areas that are not or may not be applicable in all cases. Examples are given of specific materials which can be expected to respond to high temperatures and humidities in ways not seen under normal storage conditions, but this is not meant to be a complete list, and so it is included as a note. In this case, the standard must not lead the user to believe that a product not on the list will respond in a predictable manner to the test methods later described.

Right away you can sense that one of the biggest problems with putting together a standard is maintaining precision and accuracy in describing tests for a broad range of products, some of which do not behave in as predictable a manner as we would like. In fact, the broad general cases are the easy part; the exceptions are consistently the excruciatingly difficult part.

Even though the standard gives a predictive dark fading test, that is, the results of the accelerated aging test can be used to predict a life expectancy, in years, in real storage situations, the light fading tests in the standard are not predictive and can be used only in a comparative way under the specific conditions of the tests. In other words, the purpose of the light-fading tests described in the standard is not to predict how long a color product will last under lights in a "normal" display situation, but to compare how one product fares with other products under an accelerated test condition.

The reason for this limitation is that most products exhibit at least some degree of "reciprocity failure" in accelerated light fading tests. This is explained in the Forward to the standard and again in the Introduction. Another problem with predicting life expectancy in real situations is the tremendous variety in intensity of illumination, duration of exposure, the spectral distribution of the illumination, and the ambient environmental conditions, all of which will effect the rate of fading, the degree and direction of color balance change, and the rate of yellowish staining of a displayed print.

The next Clause contains what are called "Normative References." These are the ANSI standards which constitute provisions of this standard. They are cited so that it is clear which revision of a standard is being used to support a particular passage.

Subclauses 3.3, 3.4, and 3.5 describe densitometry conditions and specify density measurement procedures. Some specific guidelines are included because they apply in particular to changes that will appear as a result of these particular tests. One major anomaly in measurement of image density when yellowish (or other) stain is present is addressed in Subclause 3.6 In order to correct for this, three methods for dmin correction of density data are offered, one pictured here.

The text refers to yet another dmin correction method. This is the power equation for dmin correction outlined in Annex F, developed by Dr. Harry Iwano and his colleagues at Fuji in Japan.

Subclause 3.7 introduces an equally complex discussion of the computation of parameters that will make sense of the data and translate it into "image life". Sample or illustrative graphs are provided to give the reader an idea of what their data will look like.

As I mentioned before, in the Forward to the standard it is explained that due to the great variety of uses for color photographs a minimum acceptable life expectancy for these materials cannot be set. Therefore the standard is limited to test methods that can be used to evaluate the life expectancy, but without judging whether certain test results would make a product acceptable or unacceptable. As an example of how endpoints might be set, the standard includes this table in which illustrative endpoints for density loss, color balance change, and dmin staining are listed for two unknown products, with the stipulation that the actual endpoints chosen for a specific application are to be determined by the user.

Subclause 3.8 provides another caveat to alert the reader. This addresses the fact that data from tests on color negatives must be interpreted to take into consideration their ability to make a good print. Such factors as color shift tolerance, staining and fading and resulting dmin imbalance, and overall density changes that may not effect spectral absorptance in the test but can effect overall image contrast in the print, must be taken into consideration when evaluating data from tests on color negatives.

Now we move on to the test procedures themselves. Clause 4 describes the dark stability test, and addresses first the two very different methods of conducting it, the "sealed bag" and "free-hanging" methods. The introduction describes the storage conditions best reproduced by each of the two test methods, that the sealed bag method best reflects conditions in storage where the photographic materials are stored in sealed containers with very little air, such as the storage of motion picture film, whereas the free-hanging method better simulates the storage of 35mm slides or reflection prints.

The rest of the Clause goes into how to set up the tests, prepare samples, determine intervals for taking density measurements, what equipment to use, and how to compute the results. The clause includes one anomaly to beware of when high humidity permits the samples to cross the so-called "glass transition temperature" and undergo a physical change which may have significant impact on fading and staining behavior.

Clause 5 describes five different light stability tests. Again the introduction to the clause lists the tests and which real-life situations they best simulate, and then goes again into the problem of reciprocity failure, the anomaly of increased or decreased fading or staining rates resulting from the accelerated test, with the suggestion that lower-intensity parallel tests may help alert the tester as to whether a particular test material is undergoing this process in his test. The clause also refers to the "enclosure effect," elaborated in Annex D, in which different dye fading and stain formation are seen between prints in and out of frames.

The rest of the Clause describes methods of measurement of irradiation, preparation of samples, procedures for setting up the five tests, and computation of the data, elaborated in an annex. Details and anomalies addressed in this clause and its related tables and annexes include the importance of the ultraviolet component in irradiation measurement, a specification for standard window glass, the relative spectral transmittance of window glass, the relative spectral power distribution for fluorescent, incandescent tungsten, and simulated indoor and outdoor daylight light sources, and the importance of the starting density in the assessment of observed changes.

Clause 6 gives instructions for reporting the results of both the light and dark stability tests. It lists specific information which must be included in a report of the results of each type of test. Here again the standard warns that endpoints to distinguish between acceptable and unacceptable product performance have not been specified. It reads, probably most clearly here:

"The subcommittee that produced this standard was not able to specify broadly applicable "acceptable" endpoints because the amount of imaging change that can be tolerated is subjective, and will vary with the product type and specific consumer or institutional requirements. Each user of this standard shall select end points for the listed parameters which, in that user's judgment, are appropriate for the specific product and intended application. Selected end points may be different for light and dark stability tests."

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If you don't know the name or number of a standard you are interested in, or just want to browse through the list, you will need access to the rather voluminous catalog of ANSI standards. The catalog is available online at http://www.ansi.org/cat_c.htm/#search.

Thanks to Henry Wilhelm, the secretary of IT9-3 and one of the founding members of IT9-3, the Color subcommittee, and to John Gignac, IT9 secretariat and member of NAPM.