Article: Key Components of the Recent Major Revision of ISO 18902 Imaging Materials – Processed Imaging Materials – Albums, Framing and Storage Materials
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Key Components of the Recent Major Revision of ISO 18902 Imaging Materials – Processed Imaging Materials – Albums, Framing and Storage Materials

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ABSTRACT

ISO 18902 *Imaging materials — Processed imaging materials — Albums, framing and storage materials* was created to help users select photo-safe enclosures and to provide guidance to manufacturers on how to make photo-safe products. However, throughout the years, the insertion, modification, and removal of provisions, disregarding the document as a whole, originated redundant or incomplete specifications that made the standard difficult to understand and to implement. Even more changes came as new imaging materials evolved and the standard's scope was expanded to include them. In 2011, the ISO committee on Physical Properties and Permanence of Imaging Materials initiated a major revision of ISO 18902:2007. The objectives of the revision were to ensure that all requirements are attainable for manufacturers, are understandable for those making enclosure purchases, and that the application of the specifications results in the standard's utmost purpose: the selection of inert enclosure materials for the storage of printed images. The key improvements made to reach these goals are discussed in this article and include: changes in scope, changes in terms and definitions, the elimination of redundant tests, the elimination of unspecified or unverifiable requirements, the elimination of irrelevant, intermittent, or incomplete information, and the development of a reporting method. The applicability of the standard to digital prints is also discussed. The improvements made to the document are expected to reflect these objectives and encourage greater usage by both the producers of storage and display materials as well as the end users.

INTRODUCTION

Standardization work in the field of still photography was initiated in 1938 under the procedures of the American National Standards Institute. Standards are developed by technical committees formed by panels of experts in the subject of concern. These committees are responsible not only for the development of new standards, but also for the periodical revision of existing ones.

The American National Standards Institute (ANSI), created the first standard concerned with selecting inert enclosures for storage of photographs: *American Standard Requirements for Photographic Filing Enclosures for Storing Processed Photographic Films, Plates, and Papers*. The earliest traceable version of this standard dates back to 1950. In 2001, the standard gained international status when ISO 18902 *Imaging materials — Processed imaging materials — Albums, framing and storage materials* was approved by the International Organization for Standardization (ISO).

Although the fundamental intention of the standard did not change, through the years the document underwent numerous fragmentary revisions by a committee body characterized by continuous turnover. This standard was created to help users select photo-safe enclosures and to provide guidance to manufacturers on how to make photo-safe products; however, the insertion, modification, and removal of provisions, disregarding the document as a whole, originated redundant or incomplete specifications that made the standard difficult to understand and to implement. Even more changes came as new imaging materials evolved and the standard's scope was expanded to include them.

In 2011, the ISO committee on Physical Properties and Permanence of Imaging Materials initiated a two-year major revision of ISO 18902:2007. The goals for the revision were to ensure that all requirements are attainable for manufacturers, that they are understandable for those making enclosure purchases, and that the application of the specifications results in the standard's utmost purpose: the selection of inert enclosure materials. To reach the desired goals it was vital for all terms to be clearly defined, for all requirements to lead to accurately determine if an enclosure is inert, for all testing to have precise protocols with established pass/fail criteria and be as cost effective as possible, and for a common reporting method, meaningful to all parties, to be implemented.

The major improvements to the standard included:

- Changes in scope
- Changes in terms and definitions
- Elimination of redundant tests
- Elimination of unspecified or unverifiable requirements
- Elimination of irrelevant, intermittent, or incomplete information
- Development of a reporting method

All of these points are discussed here, as well as the applicability of the standard to digital prints. It is important to indicate that, in this paper, the term *enclosure* is used broadly –it is meant to comprise materials used for both storage and display, including papers, plastics, adhesives, etc. Also used broadly, are the terms *photographic prints* and *prints*, which are used interchangeably and are meant to include digital prints.

The improvements made to the document are expected to reflect these objectives and encourage greater usage by both the producers of storage and display materials as well as the end users.

1. CHANGES IN SCOPE

There are several aspects involved in selecting a "good" enclosure. The ideal enclosure is chemically and physically inert, has a durable construction, and is not itself prone to decay. Previous versions of the standard have attempted to address all of these issues, but the only quality of an enclosure that could be adequately evaluated was its chemical inertness. The lack of practical ways to evaluate the other qualities resulted in a standard plagued with incomplete or inadequate requirements that left both enclosure manufacturers and institutional personnel struggling to apply it to their products and collections.

1.1 CHEMICAL INTERACTION

Chemical interactions between enclosure and print may cause the print to fade, yellow, or become brittle even when kept in proper storage conditions. There are reliable tests that can predict the potential for these types of reactions. Reactions that may cause image fade and binder yellowing can be screened with the Photographic Activity Test (PAT). Acidity, which accelerates the degradation of paper or plastic supports making the print brittle, can be assessed with a cold extraction pH measurement. Lastly, the amount of lignin, a constituent of paper known to cause deterioration of photographs, can also be assessed directly or indirectly with a Kappa Test or an Alpha-cellulose Test respectively. Furthermore, all of these tests are reasonably inexpensive, simple, and short.

1.2 PHYSICAL INTERACTION

Enclosures can also interact with prints physically, resulting in damage such as abrasion, pressure marks, blocking, or ferrotyping.

1.2.1 Abrasion

An enclosure may cause abrasion damage to a print when both surfaces are in contact and in relative motion, e.g. during transportation or when the print is inserted into or removed from an enclosure. Some enclosure materials are more abrasive than others –smoother surfaces produce less friction and are, therefore, less abrasive. Also, different prints have different sensitivity to abrasion –prints with colorants that sit on top of the paper surface, such as pigment inkjet prints, are especially at risk. Consequently, an enclosure material that is harmless to one print may be damaging to another. ISO 18947 specifies a test method to evaluate the abrasion sensitivity of printed image materials. In a similar way, a standard method to evaluate the potential for enclosure materials to induce abrasion damage in printed images could be developed.

1.2.2 Pressure marks

Enclosures with elements of different thickness –like the seams of an envelope– may put differential pressure on photographic prints or films leaving marks. The 2013 document includes an informative annex about envelope seams. In this annex, the use of envelopes with seams at the edges (rather than down the middle) of the envelope is recommended. This way, any resulting marks will be located at the margins of the image. It is also recommended that seams be smooth, free of wrinkles, and as narrow as possible to minimize the effects of differential pressure. The standard does not include any requirements concerning seams (or other elements of differential thickness), however these recommendations should work as a guideline of good practice.

1.2.3 Blocking and Ferrotyping

Blocking is the phenomenon of prints adhering to adjacent surfaces such as framing glass, enclosures, or other prints. Ferrotyping is different in that the surfaces do not go as far as adhering; rather the print undergoes a change in gloss either locally or overall.

Although blocking and ferrotyping may be favored by very smooth enclosures, in reality the texture of the surface adjacent to the photograph is less of a concern than the environment. Blocking and ferrotyping require a change in the physical characteristics of the print surface from a hard solid state to a softened gel state. The temperature at which this happens is called the glass transition temperature (Tg). The Tg of hygroscopic polymers (like gelatin) changes significantly with the moisture content. The higher the moisture content of the polymer, the lower the temperature needed to transition from the solid state to the gel state. In any case, surpassing the Tg requires high temperature and/or high RH beyond recommended storage conditions (ISO 18920, ISO 18911). When collections are kept within recommended environmental conditions the possibility of these types of damage becomes negligible.

Because blocking and ferrotyping are mostly a function of the environment, rather than the enclosure, protection against them is not included in the standard.

1.3 CONSTRUCTION/DURABILITY

The primary purpose of an enclosure is to provide physical protection to the object enclosed. An enclosure that fails to maintain its structure loses functionality and may become a hazard. Which attributes are advantageous to a given material, depends on the purpose of the material. For instance, a material used to make envelops needs to endure repetitive folding (opening and closing of the envelope) without rupture. However, when that same material is used for interleaving, folding endurance becomes irrelevant.

The previous version of the standard called for paper and paperboard materials, as well as plastics, to meet the physical tests required for the particular application of the enclosure. These tests include folding endurance (ISO 5626), tear resistance (ISO 1974, ISO 6383), and tensile strength (ISO 1924-3, ISO 527-3). However, although the standards describe the methodologies for these tests, they do not specify pass/fail limits.

Unfortunately, at the moment, there is no research available on this topic to guide in the determination of such limits. Additionally, there is an extremely large number of enclosure materials and designs to suit different needs, which makes stipulating attributes impractical, as each one would require a different set of strength tests or different pass/fail limits.

For these reasons, the requirement for these tests has been eliminated in the 2013 version of the standard. Common sense and shared anecdotal experience will have to be the guiding force when contemplating the quality of enclosure construction.

1.4 PERMANENCE

Enclosures that deteriorate and subsequently produce chemical or physical harm to prints are undesirable. Unfortunately, aside from the well-known effects of acids and lignin, not much is known about other products of enclosure deterioration and their effects on prints. A proper evaluation method should include an accelerated aging protocol, a measurable indicator of enclosure failure, and meaningful pass/fail limits. To date, this is not available.

Although all the enclosure matters described above have the potential to harm a print, because of the lack of practical evaluation methods, it was decided that the revision of ISO 18902 would focus only on specifying requirements for enclosures to ensure chemical inertness with respect to the photograph stored inside.

In addition to the changes mentioned above, the scope was expanded to explicitly include not only photograph storage materials, but also display materials including framing and glazing products. Also, unlike the previous version, spray adhesives are not excluded from this version of the standard.

In summary, the latest version of this standard –ISO 18902:2013– does not provide specifications for the design, construction, or permanence of the storage and display materials themselves. The requirements are limited to the characteristics of the storage or display materials that may affect the imaging materials chemically when stored or displayed under recommended conditions. This should make the execution of the methodology feasible, leading to greater usage of the standard by the producers of storage and display materials as well as the end users.

2. CHANGES IN TERMS AND DEFINITIONS

2.1 ACID-FREE

It is well known that acidic environments can accelerate the deterioration of objects beyond their natural decay rate. It has long been recommended that paper enclosures have a pH of 7.0 or higher. However, extremely high pH (very alkaline environments) can also cause decay, therefore an upper pH limit is just as important as the lower pH limit.

Because many users of enclosures are not familiar with pH and its meaning, manufacturers opted for the better-known term *acid-free*. Unfortunately, in the marketplace this term is used loosely and unequally. With the intention of creating some consistency, the ISO committee decided in 2007 to define acid-free papers and adhesives (plastics were not included, as the plastics listed as safe in the document are not acidic by nature). Following are the definitions:

- *Acid-free adhesive* - mounting adhesive with a cold extraction pH between 7.0 ± 0.2 and 9.5 ± 0.2
- *Acid-free paper or paperboard* - paper or paperboard with a cold extraction pH between 7.0 ± 0.2 and 9.5 ± 0.2 that is produced in an acid-free process and is sized in a neutral or alkaline manner

Although these definitions provided consistency, they were impractical. Because the slightest absorption of carbon dioxide from the air can make the water slightly acidic, “pure” water will often have a tested pH below 7.0. Therefore, neutral materials may produce pH measurements below 7.0. With the old definition of *acid-free*, these materials would be classified as acidic, even when the acidic reading was actually due to the pH of the water and not the test material itself.

To eliminate the effect of the carbon dioxide absorption on the pH measurement of water, the committee decided to reformulate the definition of *acid-free* in the 2013 version of the standard as the following:

- *acid-free adhesive* - adhesive with a cold extraction pH equal to or greater than the reference water minus 0.5 and less than 10.0
- *acid-free paper or paperboard* - paper or paperboard with a cold extraction pH equal to or greater than reference water minus 0.5 and less than 10.0

The new method is not an absolute reading of pH taken from a meter. Instead, it is a comparison of the sample in question to a blank sample of the test water.

2.2 ARCHIVAL

The term *archival* has long been co-opted by marketers to imply longevity and inertness. However, it is not a measurable quality of a particular type of housing, rather *intent;* and as such, it lacks meaning. In an attempt to create awareness of the ambiguity of the term *archival*, the ISO committee decided to incorporate a definition in the 2007 version of the standard along with a note of disapproval. The term was defined as a "material that can be expected to preserve images forever, so that such images can be retrieved without significant loss when properly stored," followed by a note stating "However, as no such material exists, this is a deprecated term and as such is not to be used in International Standards for imaging materials or in systems specifications." The idea that any storage product can protect a material forever is simply absurd. Objects have their own decay rates and will eventually deteriorate regardless of the box or envelope they are housed in. Since the term *archival* is not used by ISO for standards pertaining to image permanence and preservation, in ISO 18902:2013 it has been removed from the list of terms and its use is discouraged.

3. ELIMINATION OF REDUNDANT TESTS

3.1 PAT AND REDUCIBLE SULPHUR

Reducible sulphur is a substance known to have the potential to harm prints by causing oxidation of the imaging material. However, its presence alone is not enough to predict future damage. Although the Reducible Sulphur Test –TAPPI T 406 – detects and quantifies sulphur, the degree of damage caused by reducible sulphur has never been calibrated to the amount present. Furthermore, in some cases, sulphur may have a protective role (Reilly 1991). Regardless of the significance of the results of this test, reducible sulphur is only one of the many components that may induce oxidations harmful to prints. However, there is another test that detects the oxidation itself, regardless of its origin: the Photographic Activity Test –ISO 18916.

The Photographic Activity Test, widely known as the PAT, detects oxidation and reduction reactions that may cause fade or darkening of the image and detects compounds that may cause yellowing of the print. For this, the PAT uses two very sensitive standardized detectors. This test has been carefully calibrated using known good and bad enclosure materials as benchmarks. The calibration and sensitivity of the PAT are key in making it an effective assessment of an enclosure's potential to damage prints.

Because the PAT is a more comprehensive and reliable test than the Reducible Sulphur Test, the latter has been removed from the standard.

3.2 LIGNIN AND ALPHA-CELLULOSE CONTENT

Unpurified papers are rich in lignin, which is known to generate oxidizers, reducers, acids, and chromophores over time, inducing the deterioration of prints. Prints stored with enclosures that contain high levels of lignin undergo silver image deterioration and paper staining. In the purification process, wood pulp is ridded of lignin and other components (i.e. hemicellulose and extractables) leaving behind alpha-cellulose. So, the more purified a paper is, the less lignin and the more alpha-cellulose it contains.

The previous version of the standard required paper and board materials to contain 87% alpha-cellulose as determined in ISO 699 *and* to be lignin-free with a Kappa number of 7 or less when measured by the method described in ISO 302. Given that the content of lignin is inversely proportional to the content of alpha-cellulose, there is no need to determine both –doing so only adds expense and complication to the process. For this reason, it was decided to remove one of the tests from the standard. Since most people are more familiar with the term *lignin* than the term *alpha-cellulose*, it was decided to keep the determination of Kappa number and remove the determination of alpha-cellulose content.

3.3 PH AND ALUM-ROSIN SIZING

The previous version of the standard included a requirement banning paper and board materials containing alum-rosin sizing. Objection to alum-rosin is due to the acidity associated with it. Since harmful levels of acid can be detected by the cold extraction pH test (TAPPI T 509) also encompassed in the standard, the requirement to exclude alum-rosin is redundant and has been removed from the standard.

4. ELIMINATION OF UNSPECIFIED OR UNVERIFIABLE REQUIREMENTS

The previous version of the standard required enclosures to have certain characteristics, but failed to offer a method to verify these, let alone a pass/fail limit.

4.1 PAPER

Papers were required to be free of knots, shives, and other abrasive particles, surface fibers that might offset into the image layers, as well as plasticizers, waxes, and “other ingredients” that may transfer to the photographic print or film during storage. While, these requirements may make sense, it was impossible for manufacturers to comply without an applicable test method.

4.2 PLASTIC

Plastics were required to not be “highly” plasticized. However, no test method was cited, nor has the limit of acceptability been established. The revised version of the standard simply disallows the use of plastics containing plasticizers –without a threshold. The document provides examples

of safe plastics (polyester, polystyrene, polyethylene, and spun-bonded polyolefins) –these are unplasticized, and disallows PVC which contains plasticizers.

5. ELIMINATION OF IRRELEVANT, INTERMITTENT, OR INCOMPLETE INFORMATION

In the previous version of the standard, the occasional addition of "helpful information" scattered among, and only loosely related to the requirements, was problematic. This lack of separation between requirements and helpful facts gave the reader the impression that these facts were significant points of high concern that should somehow be addressed in order to be in compliance with ISO 18902.

This was the case for information on slip-agents. The previous version of the standard included a paragraph dedicated to a discussion of slip agents and how some plastics exude these substances causing a waxy residue that may transfer to the object stored inside the enclosure. Although true, this information is incomplete and unnecessarily alarming. Slip agents are generally inert substances added during plastic manufacturing to aid the flow during processing and prevent sticking to adjacent surfaces. It has been found that some plastics exude these substances slowly over time giving a white cast to clear plastic films. There are no published reports of these substances ever causing harm to photographs and they have always passed the Photographic Activity Test. Including this information amid the requirements created a false sense of importance and the impression that such plastics may be unsuitable for use, which is likely not the case. For these reasons information on slip agents was moved to an annex at the back of the standard.

Also problematic was the inclusion of irrelevant information sometimes scattered in between the requirements, other times grouped –but still irrelevant. This was the case of a whole page dedicated to the distinction between original photographs and copies made for reference. The importance of this distinction is not denied, however it is out of the scope of this standard, as originals and copies should equally be stored in approved enclosures. For this reason, this information has no place in the document and has been removed.

In summary, all irrelevant information was removed from the standard, whereas pertinent information considered educational was moved to an annex. Annexes are not considered official parts of the standard. This should provide clarity on which qualities constitute requirements.

6. DEVELOPMENT OF A REPORTING METHOD

Having a method for reporting ensures that all pertinent information is included and formatted in a way that makes comparisons between reports consistent and easy to interpret. ISO 18902 lacked such a method.

In the revised version of the standard a list of items to be reported is given. The first four are required for all storage enclosure, photo album, and display materials:

1. *Reference to the International Standard*. There must be explicit reference to ISO 18902:2013. This simply provides information to the user on specifically which standard was used. While there are currently no other competing standards on storage enclosures, albums, and display material for photographs, there are many instances where competing standards exist and the specific standard should be pointed out. For example, there are multiple pH test standards.
2. *Material type*. The type of material tested should be given as per the categories included in the standard (i.e. paper and board, plastic, metal, adhesive, etc.).
3. *Intended usage*. Is the tested material intended to be used alone or as a component of an enclosure?
4. *PAT result*. The result of the PAT as per ISO 18916 must be reported for every material under the scope of the standard including, but not limited to, papers, plastics, and adhesives. This is simply an overall pass/fail result.

The second set of reporting requirements are material specific:

5. *pH result*. The pH results must be reported for paper, paperboards and adhesives. For all other materials, this reporting can be indicated as "not applicable."
6. *Alkaline reserve*. The percentage alkaline reserve of paper and paperboard must be reported. For all other materials, this reporting can be indicated as "not applicable."
7. *Kappa number*. The KAPPA number of paper and paperboard must be reported. For all other materials, this reporting can be indicated as "not applicable."
8. *Colorant bleed*. Results of colorant bleed must be reported for paper and paperboard, as well as writing, labeling and printing colorants. For all other materials, this reporting can be indicated as "not applicable."
9. *Plastic type*. The type of plastic must be disclosed (e.g. polyester, acetate, polyvinyl chloride). For materials other than plastics, this reporting can be indicated as "not applicable."

As an example:

1. Meets the requirements of ISO 18902:2013
2. Material type: Paper
3. Intended usage: As component of an envelope
4. PAT result: Pass
5. pH result: 8.4
6. Alkaline reserve: 3.3%
7. Kappa number: 3
8. Colorant bleed: n/a
9. Plastic type: n/a

According to this International Standard, all materials or products require annual evaluation and testing unless the specific lot of material was previously tested. IPI therefore recommends that dates be provided for all tests and evaluations included in the report. (Note that retesting is also required according to this International Standard if the formulation or any component supplier changes.)

STILL A PROBLEM: DIGITAL PRINTS

An area of great concern that was not adequately addressed during the recent revision is the housing and display materials to be used for digital prints including inkjet, electrophotography, and dye sublimation. These processes were added to the scope of ISO 18902 during the 2007 revision. Even though all three processes had already been in use for many years, they were not included in the prior 2001 revision. There are no references within the 2007 revision justifying the applicability of the standard to these newer processes. Since the digital hardcopy types can manifest decay in the same way as traditional print types (mainly fade and yellowing), it was merely assumed that the same forces must be causing the damage and they do so to a similar degree. However, research carried-out by IPI has shown that although digital and traditional prints share some vulnerabilities, in general they respond to different factors in different degrees.

In 2010, IPI presented "Selecting Suitable Enclosures for Digitally Printed Materials" (Burge 2010). This is likely the first paper to assess the reactivity of digital prints to enclosures. In this study, in general, digital prints tended to be less reactive with paper and plastic than traditional prints (other materials were not included in this study).

In 2011, IPI published **"**The Effects of Various Adhesives on Dye and Pigment-based Inkjet and Dye Sublimation Prints" (Gordeladze 2011). In this case, the study showed that some digitally printed materials are vulnerable to certain adhesives even though these had passed the PAT. The fact that the PAT could not predict the reactivity, is proof that digital and traditional prints have different vulnerabilities when it comes to enclosure and display materials. Despite the evidence, the committee chose not to make exceptions to the applicability of ISO 18902 to digital prints, but to merely provide a warning that chemical damage may occur between pressure-sensitive adhesives and non-resin-coated inkjet prints. Unfortunately, a warning may not be enough to protect the interest of those truly concerned with the selection of inert adhesives. This may be an acceptable risk for manufacturers of consumer-grade products, but it is not acceptable for institutions collecting objects of high cultural or monetary value. For this reason, IPI recommends that cultural institutions not rely on this standard when selecting adhesives for digitally printed objects. It should be used only as a first step to selection. Any adhesive that does not meet the standard should not be used; however, adhesives that meet the standard must not be assumed to be safe.

In addition to the requirements for adhesives in ISO 18902, IPI recommends not to apply adhesives directly to inkjet prints on non-resin-coated papers (i.e. plain papers, watercolor papers, fine art inkjet) as deep yellow stains may form. Physical methods for mounting are preferred (e.g. photo corners, straps, etc.). Water-based adhesives, such as starch paste, can induce bleed of dye inkjets when moisture is wicked through the paper. For this reason, they should only be applied to the reverse of unprinted areas of the print such as a white border.

CONCLUSIONS

The revision of the ISO 18902 *Imaging materials – Processed imaging materials –Albums, framing and storage materials* standard should make the document more user friendly for both manufacturers and cultural institutions. Complexities and redundancies have been removed while

maintaining the quality of output from the requirements. Through the new reporting method, the data demonstrating whether the standard has been met can be easily communicated to the supplier and the purchaser. It is hoped that these improvements will lead to greater usage of the standard by all parties involved.

It should be pointed out that any user may add further criteria to ensure their needs are truly met. For example, fold endurance limitations for envelope paper are not included in ISO 18902, but may be of concern. However, standardized methods should be cited with specific limits agreed upon between supplier and purchaser. These additional requirements will have to be arranged between the interested parties on a case-by-case basis.

ISO 18902:2013 is available at www.iso.org.

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