

# Research into the Design, Testing, and Practical Application of a Secondary Protective Housing System for Daguerreotypes

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Research work completed during the 3<sup>rd</sup> Cycle of the Advanced Residency Program  
September 2003 – August 2005



Abstract:

*This research outlines the design, testing, and practical application of a secondary protective housing system for daguerreotypes developed for a major, multi-venue, daguerreotype exhibition.*

## **I. Introduction**

Goals and objectives

The primary goal for this work was to design, prototype, test, and build a protective daguerreotype preservation housing system that could be applied to the *Young America* exhibition of the daguerreotypes of Southworth & Hawes. The objectives were project oriented, and resulted in a practical design that was implemented in the exhibition process. The paper describes the research rationale, testing methods and results, and a final design for the housing system that was incorporated into the exhibit. The concluding section addresses further research directions for evaluating and improving the design and testing of the daguerreotype preservation package and secondary housing environments.

Background

This applied research is a direct continuation of the exhaustive investigation of daguerreotype bindings and housings, and their preservation and environmental impacts conducted by Hanako Murata in 2003 entitled: *Investigation of Historical and Modern Conservation Daguerreotype Housings*.<sup>1</sup> This work stands out as a definitive study on the subject, and it was also motivated by the upcoming exhibition of the daguerreotypes of Southworth & Hawes that was in the conceptual planning stages at the time of her research. Murata's studies conclusively showed the air permeability of the standard modern methods of binding daguerreotypes and concluded that a beneficial area of further research was to incorporate a secondary housing system to improve the preservation environment for daguerreotypes.

The *Young America* exhibition featuring daguerreotypes exclusively from the studio of the Boston daguerreotype partners, Southworth & Hawes, is a collaborative exhibition

between the International Center of Photography (ICP) and the George Eastman House International Museum of Photography & Film. It opened to critical acclaim at ICP on June 17, 2005. The challenges presented by the exhibition of daguerreotypes are many, and in the case of this exhibition of approximately 160 daguerreotypes, it involved multiple institutions, private lenders, and a core selection of approximately 60 plates from the collections of the George Eastman House International Museum of Photography & Film. The exhibition was planned for three venues: The International Center for Photography (NYC), June 17 – September 4, 2005; The George Eastman House International Museum of Photography & Film (Rochester, NY), October 1 – January 8, 2006; and the Addison Gallery (Andover, MA) January 13 – April 09, 2006.

#### The Collaborative Consortium

From the early planning stages, meeting the conservation requirements inherent in mounting a major exhibit of daguerreotypes was acknowledged to be a key underlying effort of this exhibition. *Young America* is not the largest exhibition of daguerreotypes to be mounted recently, nor even necessarily the most complex, but it is significant in that it is comprised of the works of a single studio that has significant representation in three major American museums: the George Eastman House International Museum of Photography & Film, The Metropolitan Museum of Art, and the Museum of Fine Arts, Boston. Mr. Grant Romer, Director of the Advanced Residency Program in Photograph Conservation, long-time Conservator at the George Eastman House International Museum of Photography & Film, and Curator of the *Young America* exhibit, brought the three institutions together as a consortium with the purpose of advancing preservation practices for the stewardship of institutions with significant daguerreotype holdings, but with the immediate conservation concern being the shared responsibilities of the upcoming exhibition. The holdings of the three institutions comprise nearly 1,500 daguerreotypes of a known extant body of work of 2,500 works held in other institutions and by private owners. As a group overall, these works have been more observed, documented, and anecdotally reported upon, than the works of any other single maker of daguerreotypes. Concerns in the past had been raised about image deterioration and stability, previous cleaning campaigns, and all the very relevant issues related to the

preservation and exhibition of daguerreotypes overall. A first meeting of the Consortium took place on December 07, 2004 at the Metropolitan Museum<sup>2</sup>, and resulted in the acknowledged need for unified standards and a body of research to help guide institutions in the exhibition and storage of daguerreotypes. The *Young America* exhibition was viewed as a first step toward a more directed approach in documenting condition and controlling microenvironments for the exhibition and transit of daguerreotypes. The preliminary design and testing of an exhibition Preservation Package, a micro-environmentally controlled housing was presented at that meeting, as well as preliminary results of testing the thermal effects of lighting systems on sealed exhibition packages.

A key point raised in the meeting was the clear need for better documentation of condition for these linked collections, and daguerreotypes in general. None of the institution has complete records of condition transcending the multiple eras of curators and conservators, records that allow a satisfactory interpretable record of condition and actions that may have occurred throughout the life of the plates while in the care of the various institutions. Visual documentation and its interpretation is difficult at best with any class of object, but daguerreotypes present an extreme documentation challenge, given the reflective surface and the difficulty in recording subtle differences in density and tone that may be indicative of environmentally induced changes in surface. Each lighting condition dramatically alters what the viewer (or camera) sees, and the documentation challenge is to establish a base-line condition image for future reference. The documentation program for this exhibition has led to a program of high resolution digital imaging and condition reporting that is described in a corollary document, *The Digital Image Condition Reporting Program for the "Young America" Exhibition of the Daguerreotypes of Southworth & Hawes*<sup>3</sup>.

## **II. Rationale for a secondary preservation package for daguerreotypes in the *Young America* exhibition:**

There are numerous studies on the mechanisms of deterioration that affect the surface and hence visual quality of the daguerreotype. The most complete explanation of these mechanisms and the role atmospheric and environmental condition plays in the deterioration of daguerreotypes are outlined in the book “The Daguerreotype: Nineteenth Century Technology and Modern Science” by Susan Barger and William White<sup>4</sup>. However, even with a general understanding of corrosion mechanisms and the well documented and studied development of corrosion films that obscure image and diminish the viability of the object, there remains an incomplete understanding of specific metal interactions that may pertain with the complex surface chemistry of the daguerreotype. The precise rate and scale at which the possible metal oxides are formed, and when they are manifested in what the viewer might consider image deterioration or visual disfigurement, appear to be idiosyncratic to a given daguerreotype and its particular manufacture, use, and history –or archaeology. Likewise, it is well understood that there may have been other chemical interactions, possibly intentional tarnish removal or “cleaning” carried out during the life of a daguerreotype, and thus residual active chemical species, possibly cyanide or thiourea, may be present. Barger and others speculate that most surviving daguerreotypes have been through some intervention, and also that the decomposition of cover glasses and the presence of hygroscopic alkaline salts are a factor in the producing corrosion sites on the plates. The binding and housing materials themselves are suspected to be sources of contamination that lead to image deterioration. There has been little study on the presence of organic contaminants or possible coatings on daguerreotypes that may be factors in producing a visual disturbance on the plate: trace materials that may be responsive to light energy, temperature, and moisture.

The collections of Southworth & Hawes daguerreotypes held at the George Eastman House are in unit package that generally consist of a 2-ply rag-board, ¼” wide, die-cut

spacer that separates the cover glass from the daguerreotype plate, and incorporates standard framing glass that is bound to a 4-ply mat-board backing with a perimeter binding tape of Filmoplast P-90. Variations on this modern binding system for uncased daguerreotypes have been used at the George Eastman House and in many other institutions and private collections since the 1970's (Reviewed in depth by Murata)<sup>1</sup>.

This earlier research conclusively documented the permeability of these packages to ambient atmospheric conditions. The exhibition design called for many of the whole plate daguerreotype packages from the George Eastman House and other similarly bound plates to go into modern wooden frames modeled from frames attributed to the studio of Southworth & Hawes. The design choice of framing materials included walnut, traditional oil stains, and sulfonated alkyd paints and driers. Although testing all products to be used in an exhibition and choosing only "safe" materials is always desirable, it is often unrealistic in many instances. In the case of this exhibition, placing the daguerreotype package into a sealed, secondary preservation housing based on this research was considered a viable option. Furthermore, scheduling was such that the frames were to be produced within months or even weeks of the exhibit installation, and thereby raising the concern for a more protective immediate micro-environment for as many of the exhibition plates as possible.

The secondary preservation package housing system for daguerreotypes proposed and incorporated into in the *Young America* exhibition resulted from a prototype and testing period dictated largely by the exhibition schedule. Fortunately, satisfactory preliminary test results moved the project from prototype design to implementation shortly after the conclusion of a series of environmental test runs. It is important to outline the time frame driving this research project: the preservation package concept design was proposed in October, 2004, and final design and testing was completed in mid March 2005. The final deadline for completion of all conservation and exhibit preparation work was May 20, 2005, prior to a June 1 shipping date to ICP.

### **III. Research, Design, and Testing of the Preservation Package**

The October 1, 2004 proposal entitled “Rationale and Initial Testing Protocol for a Secondary Preservation Housing for Daguerreotypes”<sup>5</sup> follows closely to the actual testing that was carried out. The primary goals of the proposal were met by the final design as implemented. The final design incorporated some significant modifications that will be discussed.

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## **PROPOSAL**

### **Rationale and Initial Testing Protocol for a Secondary Preservation Housing for Daguerreotypes**

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October 1, 2004

The following proposed secondary preservation package is intended to provide additional environmental and physical protection for daguerreotypes that are in a housing system widely used in museum collections, referred to here as the “archive package”. The typical museum archive package consists of: cover glass, paper spacer, mat-board backing, with a paper-based pressure sensitive binding tape around the edges. The research paper: *Investigation of Historical and Modern Conservation Daguerreotypes Housings*, by Hanako Murata, 2003 (unpublished; Advanced Residency in Photograph Conservation, George Eastman House International Museum of Photography and Film), conclusively demonstrated that this package is permeable and responsive to the prevailing exterior environmental conditions. The physical protection and moderate slowing of air movement through the package is considered appropriate for controlled storage and archive conditions, but in changing and uncontrolled conditions, such as exhibition and transit, it does not provide adequate protection for the daguerreotype plate.

The design parameters of a secondary preservation package for the archive package are intended to meet the following criteria:

1. To provide a high level of physical protection to the plate package
2. To significantly slow air and moisture permeability into the primary package.
3. It is constructed materials that pass the Photograph Activity Test, and are considered “safe” for use in proximity to silver, and silver image formed materials, and if testing bears out, daguerreotypes specifically.
4. It has the potential to scavenge damaging reactive species (from the exterior environment) preferentially to the image silver and provide a “preservation atmosphere”.
5. It can be cost effectively made and implemented into the workflow of exhibit preparation.
6. It allows for easy removal of the plate package without damage to the binding tape or housing materials.
7. It has a profile and size that accommodates easy inclusion into (standard) framing and exhibit mounts.

Proposed design:

1. The secondary package will be made from 20 oz/ft<sup>2</sup> sheet copper with a lip edge approximately the depth of the thickness of the archive package. The overall dimensions will allow for easy insertion of the package, but will retain it with minimal excess space. The corners will be soldered and considered sealed. The copper will be sanded on the interior to provide a high surface area of fresh and non-oxidized copper, degreased and cleaned just prior to sealing the package.
  - a. Pure sheet copper is a physical and moisture barrier.
  - b. The copper will provide a high reservoir of reactive metal that theoretically will react to oxygen and sulfur bearing compounds preferentially to the daguerreotype, and the copper is more available for reaction to the air that first comes into the preservation package through the most external seal. (Note the use of Intercept™, a copper impregnated polyethylene is widely used for a preservation storage environment for fine silver objects in museum storage).

2. The archive package will be sealed into the copper tray with a metal foil tape with an acrylic adhesive, Polyken 330™, made by Tyco Industries. This tape is formulated for high temperature and exterior use, and was offered as an appropriate exhibition material in the AIC Workshop on Conservation Exhibition Display Cases (Dallas 2001). The tape application will wrap around the copper edge in four strips and adhere to the cover glass of the daguerreotype package. Note that the minimal extension onto the cover glass will be hidden behind the framing mat. It will be modified and applied as follows to overcome some obvious problems:
  - a. The paper edge seal of the archive package will be isolated from contact with the pressure sensitive adhesive of the foil tape by a barrier strip of ½” Teflon tape applied across the adhesive bearing side of the foil tape.
  - b. The ¾” wide foil tape strip will extend approximately 1mm onto the cover glass, extending just beyond the paper binding tape edge of the package, thus providing a seal to the glass. The section of adhesive below the Teflon barrier tape will seal to the raised lip edge of the copper tray. This process will be repeated around all four edges of the package.
  - c. Conditions at the time of package insertion will be controlled and measured. If the tests demonstrate benefit, the archive plate package will be placed into the secondary preservation package at a specified R.H., anticipated to be below 40%, to minimize trapping moisture into the package.

### **Initial Performance testing of the proposed design:**

These initial testing procedures are designed to provide a preliminary level qualitative performance evaluation of the secondary preservation package design concept. It is expected that in the course of testing, additional tests and refinements may be necessary to understand and verify results. Existing observations and knowledge of corrosion patterns and air and moisture movement within the daguerreotype package guides and cautions these preliminary experiments to the challenge of interpreting testing data in complex, multi-variable system.

The initial testing procedures proposed here are intended to compare the environmental protection benefit of the copper secondary package to that of the museum archive package alone. Three separate tests are to be carried out with simulated packages in a sealed testing chamber that can be visually monitored. Additional tests will be run on materials used with the system.

**Test 1: Air flow and seal performance:**

The secondary preservation package and the archive package will be placed in a glass, sealed testing chamber. Inside each package will be A.D. test paper that rapidly responds to acidic vapors indicated by color change. The chamber will contain an empirically determined amount of acetic acid based on quick tests of response of the paper alone prior to conducting the experiment.

The performance of the seal within the secondary preservation package can be compared to that of the archive package alone. Depending on these first results, additional performance information can be derived by slightly moderating chamber pressure consistent with barometric pressure changes. This can be monitored with a simple barometer placed within the chamber and a measured air volume added or removed through a chamber port.

**Test 2: Corrosion and oxidation protection afforded by the reactive copper tray:**

Using a set-up similar to the above experiment, the A.D. paper is replaced with a strip(s) of the highly reactive colloidal silver paper that is used in P.A.T. testing. This paper is placed in both the secondary preservation package and the archive package. The proposed source of reactant will be polysulfide toner. It should react quickly with the colloidal silver test strip to give a characteristic color change. Again the response of the unprotected colloidal silver test paper to the polysulfide toner within the chamber will be a base-line test prior to placing the test packages.

**Test 3: Moisture response:**

The same test set-up can be run at high humidity by placing a moisture source within the chamber and using humidity indicator papers for rough determination of package response.

*N.B. All these tests can be run at different relative humidities and temperatures, which may reveal more performance data. Only ambient room temperature and R.H tests (conditions will be recorded) for air flow and reactivity, in addition to the simple humidity test, will be done at this point to test initial performance.*

Test 4: Tape adhesion and response with temperature and/or humidity variations:

The performance of the tape adhesive (and Teflon barrier tape system) will be tested to verify that it can be easily removed, that the Teflon is an effective isolating barrier, and that the materials remain stable in extreme conditions. The tape system will be simulated by applying samples across a copper/glass test substrate, and heating and cooling them in varying humidity conditions. The adhesion and removal characteristics will be compared to a control.

*N.B. The testing protocol will probably repeat the P.A.T. test on the Polyken 330 with a recent production batch to ensure its use within these design specifications.*

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### **Discussion:**

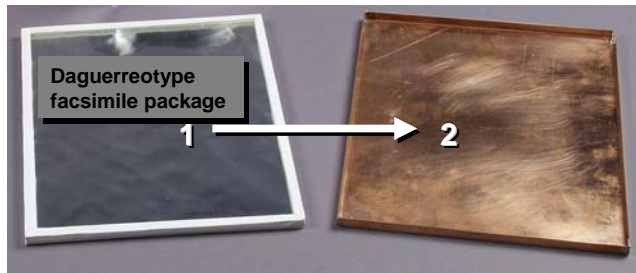
Preservation package prototype and testing program

The comprehensive testing of daguerreotype binding systems carried out in Murata's research utilizing A-D Acid Detection Strips<sup>5</sup> and relative humidity cobalt salt indicator strips were the basis for a simplified testing protocol for package permeability and direct comparative evaluation of prototype test packages. These previous tests had established a good model for testing the degree of seal in similar packages. Because the focus of this research was on testing the whole plate daguerreotype format (6 ½ " x 8 ½") that were to be placed in modern frames, the tests were conducted solely with that format.

For simplicity and expediency given the constraints of time, the tests were carried out in a standard 7 liter glass desiccator vessel with a vent port. This set-up allowed constant visual monitoring and was necessary for the pressure variation testing –a test that was not a component of Murata's investigation.

## Elements of the exhibition preservation housing for uncased daguerreotype packages

- Facsimile testing protocol of a removable sealed package -

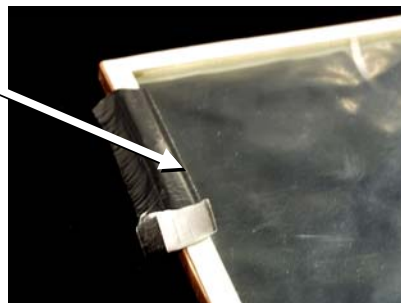


Archive package (1) is placed into formed copper tray (2)

The copper tray provides physical protection and potentially can act as a reservoir of reactive metal that can scavenge pollutants before they react with the silver image of the daguerreotype



Demonstration section of foil tape: Teflon barrier strip isolates binding tape from foil tape adhesive



Aluminum foil backed tape (3M 427) has an acrylic, low emission, pressure sensitive adhesive. The tape creates a sealed package containing the daguerreotype. A thin edge of tape adheres to the glass and wraps around to seal to the copper tray. It does not contact the Archive Package binding tape.

Although this illustration shows the elements of the package that underwent testing, the rationale for using a copper tray and its perceived benefits was not tested independently. The use of copper as the secondary housing developed out of its ease of fabrication and availability of a vendor for supply, as well as its similar reactivity to materials comprising the daguerreotype itself. A far more detailed study needs to be done to measure and quantify the particular benefits provided by the high surface area of the copper in this sealed system; time did not allow that testing. Work done in atmospheric testing using silver and copper coupons by Purafil™ Corporation<sup>6,7</sup> discusses in depth the reactivity of these two metals to atmospheric and environmental conditions. Other studies for the micro-electronics industry show the complexity of the corrosion systems and the challenge of quantifying both beneficial effects of the copper reservoir, as well as that of understanding complex corrosion systems on daguerreotypes in general.<sup>8</sup>

One of the challenges to fabricating the preservation package was the design parameter ensuring the system would not damage the paper carrier of the Filmoplast P-90 binding tape on the archive package. As beneficial or technically possible it might have been to

re-house the plates to improve immediate plate environment and seal, or better yet, engineer an alternative sealed package from the “ground up”, there was scant time to meet deadlines with this design –let alone time or resources to prototype and build a more elaborate one. Even if it were feasible with the collections from the George Eastman House, there were an additional twenty whole plates from other institutions and private owners in similar package that were to go into frames. Opening and changing the binding system is considered a significant treatment and would have required individual treatment agreements and authorizations which were well beyond the scope of the exhibition. The exhibition frame fortunately incorporated a brass mat overlay providing several millimeters of space in which to adhere the foil tape to the glass so that it would not be visible. The Teflon barrier tape isolates the Filmoplast P90 tape, and in each instance in which the archive package has been removed from the preservation housing, there has been no damage to the integrity of the binding.

Notes on the preparation of the copper tray:

The first set of tests were run with a copper tray fabricated in-house. The corners were clipped and folded around and silver-soldered to complete a seal. The final dimensions of the tray fabricated from 20 oz/sq. ft. copper had an interior dimension of 6 5/8 " x 8 5/8" with a raised lip edge of 5/8 ". The final production tray was fabricated by Spring Sheet Metal, South Clinton Avenue, Rochester, NY . Approximately 80 trays were ordered.

The trays were prepared for use by resurfacing the interior with 320 grit sandpaper with an orbital corner sander to increase the surface area of the copper and create a uniform fresh non-oxidized surface, and then cleaned by the following steps:

1. Rinsed in water and a non-ionic detergent.
2. Placed in an ultra-sonic cleaner with water to remove residues.
3. Degreased with acetone and wiped with paper towel until no black residue was removed. The corners were cleaned with cotton swabs to ensure no soldering fluxes or residues remained.
4. The prepared trays were placed in sealed plastic bags to prevent oxidation prior to use.

## Package Testing Program:

### First Test Series:

Comparative tests of the Archive Package and the Preservation Package. This test was carried out in a sealed chamber maintained at constant ambient pressure conditions.

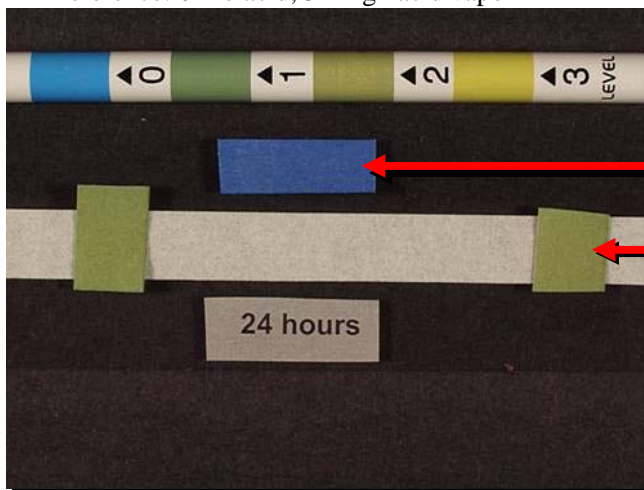


A test archive package and a test preservation package are placed in a reaction vessel containing acetic acid. Acetic acid vapor indicator strips are inside the packages and monitored for changes. A color change indicates that the acid vapor (thus air) is getting inside the package.

[AD™ acetic acid indicator strips are a preservation product from *Image Permanence Institute*]

### Explanation of the AD Acid Indicator Paper Reaction Colors

Reference: 0=no acid, 3= high acid vapor



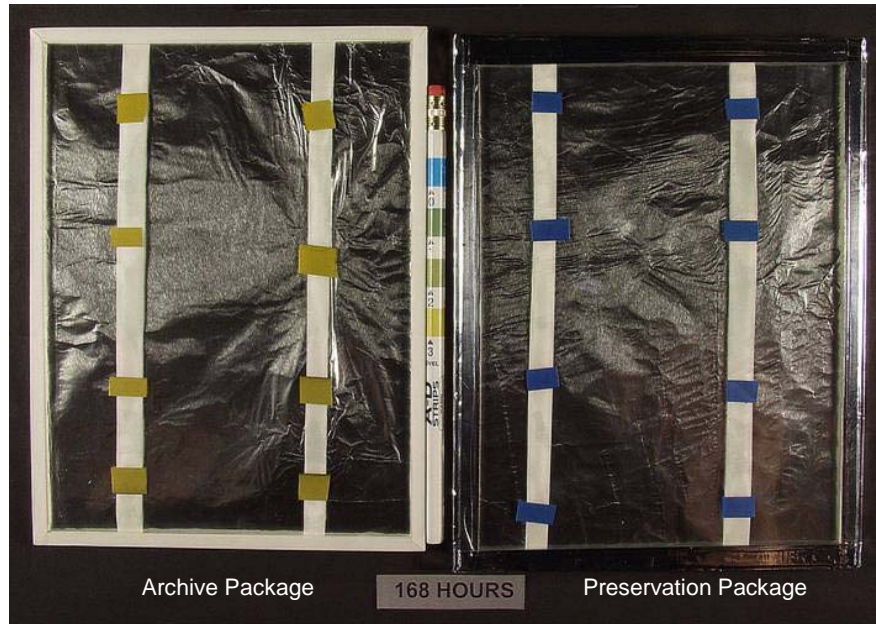
Unreacted AD indicator strip

AD indicator paper exposed chamber with acetic acid for hours

6 drops of glacial acetic acid blotter paper placed in the bottom of the chamber provided the acidic environment for this test

The test set-up economized on the use of A-D strip paper by using segments attached to a thin strip of Filmoplast P90, adhesive side up beneath the cover glass. Aluminum foil wrapped around a non-buffered 6 ½ " x 8 ½ " piece of matboard simulated the daguerreotype.

First Test Series demonstrates no detectible acetic acid permeability of the Preservation Package in constant pressure conditions, indicated by the A-D strip colors, and high permeability for the Archive Package maintained in the same chamber conditions.



Time progression of the progressive permeability of acid vapors into the standard archive package shown in the first series of comparative package tests:

Archive Package is at equilibrium with acid vapor in chamber at 168 hours; vapor has fully permeated the package

Preservation Package No detectible acid vapor permeates the package in 168 hours;



Top row: Archive Package imaged at 48 hours, 96 hours, and 168 hours

*(a fresh unreacted AD strip is placed on top of glass for comparison)*

Bottom row: Preservation Package imaged at 168 hours

The First Series tests were informative in giving a baseline comparison of the rate of permeability of the archive package to that of the significant higher level of seal afforded by the barrier of a copper tray and the aluminum tape of the preservation package. However a test run in a sealed chamber at constant pressure does not simulate actual real-world conditions. Atmospheric barometric pressure changes place significant stresses on maintaining a sealed micro-environment; average sea-level barometric pressure is 29.923 inches of mercury, and normal variations range around 2 – 4 % within daily fluctuations and high and low pressure systems. Extreme recorded barometric conditions vary from a record high of 32.06 inches of mercury, to a record low reading of 25.69 inches of mercury. These extremes correspond to a 19.3% fluctuation in barometric pressure<sup>9</sup>.

The Second Test series set-up was similar to the First Test series, however it was designed to simulate real-life conditions by varying pressure in the test chamber. A measured amount of the chamber atmosphere was removed through the vent port, creating low pressure conditions, and on a prescribed cycle the port was opened to return the chamber to ambient room pressure. When the chamber was at ambient conditions, 2-3 drops of glacial acetic acid were added to the blotting paper in the chamber to qualitatively maintain the acid vapor concentration. *Boyles Law* of the behavior of gasses states that the pressure of a gas is inversely proportional to its volume:  $Pressure_1 \times Volume_1 = Pressure_2 \times Volume_2$ . Therefore by removing a percentage of “gas” volume from the chamber equivalent to normal barometric pressure changes, there would be a pressure differential within the sealed package forcing it to come to equilibrium with the new chamber pressure. Removing gas from the chamber would stress the seal by air attempting to escape from the package interior. If air from the package was forced out, when room air was bled back in and the pressure was now greater on outside of the package, then the acetic acid vapors would be forced into the package through failures in the seal, and the A-D strips would respond accordingly. The same preservation package that was used in the First Series was used for the Second Series testing variable pressure.

Illustration of the variable pressure test chamber used in the testing procedures.

A calibrated syringe allows for a volume to be removed from the chamber to simulate barometric pressure changes. This simple technique used the vent port of the vessel to which a section of vinyl tubing was attached. 150 ml of chamber gas was removed each cycle, corresponding to approximately 2% of the 7 liter volume of the chamber minus the volume of the package.

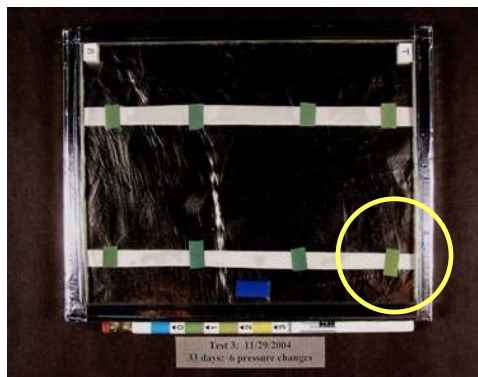


Results and discussion of the Second Test series:

#### Second Test Series:

Testing of the Preservation Package from the first test series shows reaction of AD strips to the acetic acid vapors permeating when cycled through pressure changes over several weeks.

Note that the greatest color change is in the corner AD strips.



The pressure was cycled at approximately at three day intervals over thirty-three days and induced ingress of acetic acid into the preservation package, as indicated in the color change of the A-D strips shown in the illustration. A color change in a corner strip to stage 1 was noted after the first three day cycle. At 9 days, all the corner strips had visibly reacted. The test was continued for 9 pressure changes to see if all the strips would change significantly. At 33 days the test was terminated. The corner A-D strip sections had changed to stage 2 and the center strips were quite uniformly stage 1. The binding seal of the package had been fabricated with a four strip tape overlay, and the corners were suspected to be the weak point. This is consistent with Murata's findings as well when she tested 4 the piece binding system of Filmoplast P90 vs. a continuous strip, double binding<sup>1</sup>.

Modifications in package design and changes in the testing protocol:

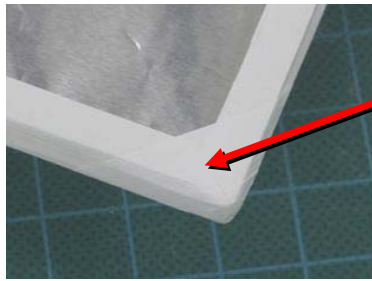
These first comparative test series were beneficial to demonstrate the significant effect of pressure changes on a package seal, as well as how permeable the archive package alone was to acetic acid vapors. However the acetic acid vapors may have been also a factor in breaking down the tape adhesive and its aggressive action introduced a variable that was not a useful component of the test. This was dramatically borne out by repeating the test with both acetic acid and moisture in which the aluminum tape backing foil was severely etched. The most relevant test series to the final design, RH Test 1, incorporated modified corners and a different foil tape.

#### RH Test 1

1. The test package was modified by using 3M™ 427 foil backed tape with an acrylic pressure adhesive and a release liner<sup>10</sup>. This change was based on further investigations of acrylic tape performance, and discussions with product engineers. The Polyken 330 adhesive had a strong odor indicating off-gassing, and it had poorer handling properties and ability to take on the conformation of the plate package compared to other foil tapes that were tried. The corners were modified with an overlay tab that sealed onto the glass at the perceived weak point of the earlier design.

2. The 3M™ 427 tape was tested by the Photograph Activity Test protocol by Image Permanence Institute<sup>11</sup>, and it passed all tests.
3. The chamber RH maintained a constant 75% RH by placing a reservoir of saturated sodium chloride solution<sup>12</sup> in the bottom. This was considered a realistic, but aggressive RH test atmosphere. A 0 – 100% cobalt salt humidity indicator card was placed on the glass shelf above the salt solution as the control for the chamber RH.
4. The preservation package was desiccated by heating the matboard prior to assembling and sealing the package. The cobalt salt 0-100% color indicator humidity card included in the package. It was visible inside the glass and verified that the interior was RH was <10%. The RH card was cut in half and the other half was placed inside the test archive package.
5. An archive package (matboard with glass and spacer) similar to the first series was assembled with the comparative RH strip indicator card beneath the glass. The package assembly was desiccated and the RH color on the card indicated <10% RH inside the package.
6. The two packages were placed inside the chamber on 1/15/2005. Pressure was not varied, and the chamber RH was stable at between 70 % and 80 %, which is the accuracy range of the step changes with the cobalt indicator sections.
6. The comparative archive package came to equilibrium with the saturated salt chamber RH conditions in 4 days in static pressure conditions (1/15/2005 - 1/19/2005). It was removed from the chamber.
7. Variable pressure cycling began on 1/19/2005 with the preservation package alone.
8. 1/19/2005 – 2/16/2005 the pressure cycling was by removing 250 ml air and returning to ambient conditions every 2- 3 days: the cycling period was not precise but it remained constant days. 250 ml change corresponds approximately to a 4 % change in barometric pressure; somewhat greater than normal ranges.
9. 2/22 – 3/04: cycled pressure by removing 500 ml air which approaches extremes in recorded atmospheric pressure changes.

Illustrations of the modifications to the preservation package in RH Test 1



Teflon tape overlay prevents foil tape adhesive contact with the Filmoplast P90 of archive package.



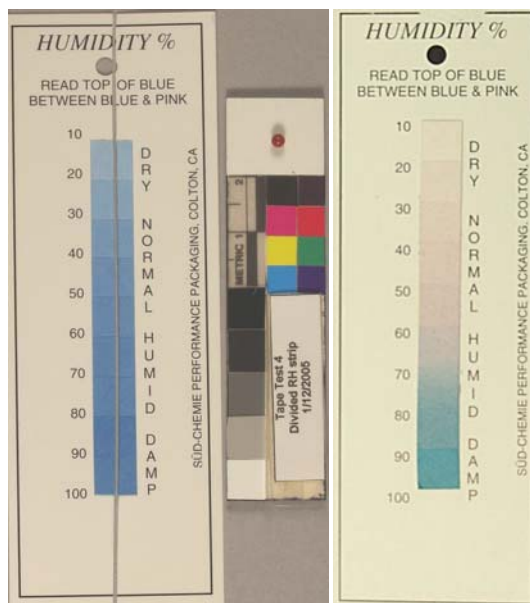
Foil tape corner tab provides for a fully enclosed corner seal, and increases the adhesive bonding surface to glass



Discussion of RH 1 Test results:

There was no visible change in the color of the humidity indicator card inside the preservation package throughout the test period and beyond.

Humidity indicator cards used in the RH Test 1 Series; Kodak color patch in center is placed as a standard color reference.



Card on the left is split for the comparative package test: color indicates < 10% RH

Card at right is the indicator color for the RH in the test chamber maintained by the saturated sodium chloride solution at approximately 72% relative humidity.

## Comparative images of the test preservation package

Before test image: 1/15/2005

Humidity card in center shows chamber RH

After test period image: 7/5/2005  
(note image taken in different lighting conditions)



The success of the sealed preservation package design with modified corners in maintaining constant RH conditions through the testing program described, led to its implementation into the Southworth & Hawes exhibition. Key to its implementation was prescribing a precise fabrication protocol. The following procedure specifications were written to train conservators and technicians in the system.

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### Steps in making the daguerreotype Preservation Package 4/10/2005

1. Label reverse of copper preservation pan with the information from the reverse of the archive plate package.
2. Temporarily secure matboard template on the cover glass of archive package (place tabs of pressure sensitive tape on reverse of template) : position so that the border edges are showing an even edge between the template and the Filmoplast binding tape.
3. Turn plate over (face down) onto the raised padded work platform that is slightly smaller than the plate, take two pieces of the pre-cut, pre-conditioned (desiccated)

matboard from their sealed package and place them onto the reverse of the archive plate package and place a piece of 6 ½ " x 8 ½ " 3 mil Mylar over them.

4. Turn the whole package over onto the work platform and place padded weight in the center to retain it. Align all edges and wrap a 3" long section of ½" Teflon tape diagonally across the corners so that it comes slightly onto the glass. Pull tightly and press the ends against the Mylar on the reverse. The static charge will temporarily hold it in place. Do this for all 4 corners.
5. Carefully turn the package over so that it is face down and secure the ends of the Teflon corner overlays with tabs of Filmoplast P90 tape (for efficiency it is helpful to have the Teflon pieces and the Filmoplast tape prepared in advance).
6. Place package in copper pan.
7. Slightly moisten a cotton swab with Ethanol or reagent alcohol and clean the glass around the edges of the Filmoplast binding edge. This ensures better adhesion of the foil tape.
8. Position the Teflon barrier foil tape with narrow adhesive margin edge contacting the cleaned glass margin. (The convention has been to place the short tape sides first). If possible do not place tape directly against the template, leaving the most space possible yet getting good contact of the adhesive strip against the glass. Carefully align the tape and lightly adhere to the glass as a preliminary positioning, burnish the tape against the glass with the Teflon burnishing tool; avoid wrinkling the tape edges.
9. When the tape strip is positioned and secured, remove the liner tabs at the end and fold the ends extending laterally down to the copper pan edge; use the Teflon burnishing tool as a support to square the corner.
10. Cut tape at corner bend back to the copper pan at the corner with fine scissors; fold extension tab back tape to the copper pan, burnish as necessary to smooth the tape. Carefully fold the long edge down around the pan onto the reverse. Work evenly along the edges to avoid wrinkles. Continue this process for all four tape edges. When all edge strips are placed, burnish the glass contact edge and the reverse with the Teflon tool. Be careful not burnish too hard and perforate the tape along the copper pan rim edge
11. Peel the liner from a corner overlay tabs and fit them snugly onto the corner of the package with the diagonal edge minimally contacting the glass at the junction of the tape overlay. Lightly burnish into position.
12. Turn the package face down and fold the corner tabs overlay onto the reverse of the copper pan. It probably works best to fold the double thickness tab first and then burnish the single thickness over it.
13. Remove template and carefully burnish all tape edges and along the glass and corner tabs, front, back and sides so there are no visible gaps in the foil tape. Avoid burnishing along the sharp copper pan edge and into the gap between the plate

package and the pan; the unsupported or sharply folded tape can be perforated from excess pressure and manipulation.

14. Burnish the tape adhesive-glass contact edges with an adjustable hot tool or heated micro-spatula to ensure a good set of the adhesive and improve the bond.

The following image sequence illustrates key fabrication steps.

#### Components of the Preservation Package

- Daguerreotype archive package (facsimile shown here)
- 2 pieces, 6 ½ " x 8 ½ ", 4-ply matboard desiccated to < 10 % RH
- 1 sheet of 6 ½ " x 8 ½" 3 mil Mylar to back the matboard
- Cleaned and prepared copper tray



Teflon tape stretched around corners



Reverse of plate package with the Teflon attached to Mylar backing sheet



Pre-cut foil tape sections with templates for cutting liner:

Tape sections 9 ½" & 7 ½"

Liner templates: 8 5/8" x 6 5/8"



Liner is cut through without cutting foil tape: at both ends of tape



Liner is pulled off to expose the tape adhesive



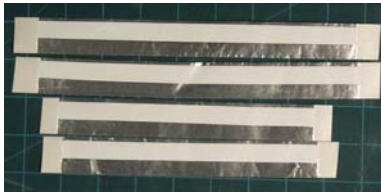
Tape is prepared for application of Teflon barrier strip



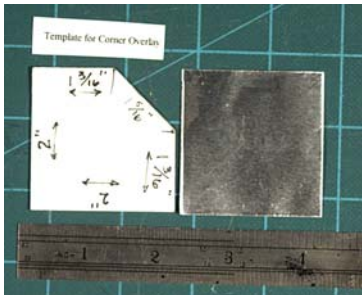
The Teflon tape is placed leaving a 2-3mm (1/16") contact edge along top edge



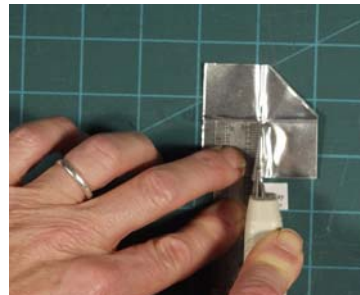
Excess Teflon ends are cut away prior to lightly burnishing the tape with fingertips to secure it to tape adhesive



The four binding strips are ready to be applied to the package. The liner tabs will be removed when sections are applied.



2" x 2" section of 427 2" tape with corner overlay template



The corner tab is folded into fourths and a cut is made to the center along one of the 1/4 section folds.



A section of liner tape is removed and the 1/4 section is folded and adhered into a right angle tab.



The folded section is burnished/pressed together to assure tight contact.



Archive package in copper tray with template corresponding to the brass mat window positioned on the glass to provide the margin edge for attaching the foil tape



Foil tape shown prior to positioning onto glass and around copper tray



Foil tape section is positioned up to the template edge



After removing the tabs of liner from the ends of the tape, the adhesive contact edge is burnished onto the glass.



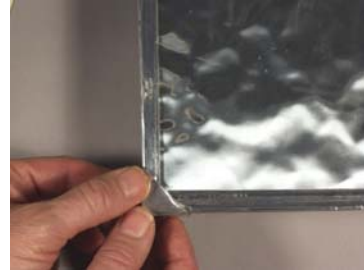
Corners are folded at right angles and cut back to the copper prior to folding in the end tab.



The corner sides are carefully pressed down to the copper and burnished



Foil tape is burnished evenly onto copper. Care is taken to smooth all wrinkles that might allow air to leak into the package



The corner tabs are aligned and pressed around the corners.



The corner tabs are folded and burnished down onto the reverse of the copper tray.



The corner overlay tab is carefully pressed and burnished to the glass at the corner 45° contact point



Preservation test package shown in one of the framing styles used in the exhibition.



Reverse of the frame with the preservation package. The rabbet margin spacer is Fomecor; the package is secured into the frame with an overlay of thin plastic sheet held by glazer's points.

**Conclusions of the testing and application of the secondary preservation package system to the *Young America* exhibition of Southworth & Hawes daguerreotypes.**

At the time of filing this research report, October 28, 2005, the *Young America* exhibition has been through two exhibition transits: from the George Eastman House International Museum of Photography & Film to the International Museum of Photography, and return to the George Eastman House for exhibition. The next phase of this research is to evaluate the condition of the daguerreotypes receiving the preservation housing and test the internal environment of selected daguerreotypes that are on exhibition. This will be ongoing while the exhibition is at the George Eastman House and will be an addendum to this research report. The cumulative condition reporting and digital imaging component of this research will provide essential comparative visual data.

The practical control of the interior housing environment for daguerreotypes and the perpetual challenge of seeking an optimum preservation environment will continue to be a work in progress for the foreseeable future. The diverse mechanisms of the silver surface deterioration inherent to daguerreotypes, and all the variables contributing to the visual changes that have been observed even in short exhibition durations, will remain an active research area with daguerreotypes.

This work stands as a practical attempt to provide a better protective environment without altering a pre-existing housing, and accomplishing it for a particular exhibition design. If the challenge instead, had been to build a primary and secondary housing system without those constraints, many of the elements in this application could be used to significant advantage with an expected improved outcome. That too will be a continuation of this initial work.

The following is a list of ongoing or anticipated activities that are a direct result of this exhibition

- Monitor, evaluate, and strive toward “better practices” \* for the exhibition and storage of daguerreotypes through meeting the challenges of this exhibit and the issues it has raised and addressed.
- Publish and place the preservation package system and variants, as presented here, to peer review and practice.
- Continue to research the preservation housing methods and materials and make improvements through repeatable and quantifiable testing protocols.
- Continue investigations into developing specialized products for use by those who are stewards and caretakers of daguerreotypes.
- Develop a surrogate or internal sampling method to monitor interior housing environments and extrapolate to daguerreotype image deterioration and corrosion rates: develop the Daguerreotype Activity Test.
- Continue and build on collaborative work among institutions with daguerreotype collections begun with the Consortium.
- Standardize the documentation and digital image based condition monitoring program initiated with this exhibition.

*\* The term “best practices” is much used and overworked, and it is my view that we can only accomplish better practices as conservators –and if we do that honestly we have done much to advance the field.*

\* \* \* \* \*

## Acknowledgements

This past year during which this exhibition was being planned, designed, and built, I had the great privilege to work with a most talented, dedicated, and supportive group of individuals as I pursued this work. My appointment as an Andrew W. Mellon Research Fellow in the Advanced Residency Program in Photograph Conservation at the George Eastman House International Museum of Photography & Film, was supported by the Andrew W. Mellon Foundation, for which I am extremely grateful.

Grant Romer, Director of the Advanced Residency Program, first approached me with the conservation concerns he had as both curator and conservator of the *Young America* exhibition, and throughout provided continual guidance, counsel, and confidence in the innovations that resulted from this research and its implementation in the exhibition. Sheila Foster, Curatorial Assistant for the exhibition was instrumental in keeping this work on track, and provided the organizational structure that integrated all phases of the exhibition, and without whom we could not have accomplished it. Taina Meller, Advanced Residency Program Fellow, my dear friend and colleague, was my partner in conceptualizing, testing, and being an honest critic of the ideas and practices presented here. Much of our collaborative work is still in the development stage, and I look forward to completing it with her for the next phase in advancing the preservation practices for daguerreotypes. I would especially like to thank Juian Juian Chen, Assistant Director, Advanced Residency Program for her guidance and experience, as well as all the fine tuning of ideas and innovations that were instituted in the Southworth & Hawes exhibition that were too numerous to be chronicled in this document, but will be part of future reports and publications. Mark Osterman, Process Historian for the Advanced Residency Program, was always available for his vast knowledge of the history and technology of daguerreotypes, original housings, and all things photographic, and whose perspective was of constant value during this work. Stacey Vandenburg, Advanced Residency Program Manager was most important in coordinating all the complex details that this deadline driven work demanded: travel, purchases, equipment, again acknowledging that any project of merit is truly a team project. Image Permanence

Institute was an important contributor to this work as well. James Reilly, Director, and Co-Director of the Advanced Residency Program, was very understanding in the demands that this research and the exhibition deadline would make on the other requirements of the Program, and gave me license to pursue it in the light of the other demands. Douglas Nishimura, Scientist, was the constant recipient of my frequently not well formulated technical questions, and was always available for his extraordinary capacity to delve deeply into the chemistry and physics of the matter at hand and provide a necessary grounding in material reality. Key advisors to the Advanced Residency Program, Martin Scott and Nicholas Graver were instrumental in their comments and insights into this work and its outcome. I would like to offer special thanks to Hanako Murata for her groundbreaking work in the 2<sup>nd</sup> Advanced Residency Program cited in this document, and that I consider much of this work an extension of her ideas and methods and the application of improving secondary housings that she projected in her research, especially in regard to this exhibition.

There are many others to thank as well who directly helped in implementing this design into the exhibition and were understanding of the conservation exhibition efforts that were being innovated in this exhibition. All of the Creative Services staff at the George Eastman House were critical to making this a collaborative institutional effort. All the Third Cycle Fellows and especially the Conservation Department Intern at the time, Wan Ping (PJ), worked on implementing the preservation package and other initiatives in this exhibition.

Ralph Wiegandt  
Andrew W. Mellon Fellow  
Advanced Residency Program in Photograph Conservation  
October 27, 2005

\* \* \* \* \*

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## Endnotes

<sup>1</sup> Murata, Hanako, *Investigation of historical and Modern Conservation Daguerreotype Housings*, George Eastman House International Museum of Photography & Film, Advanced Residency Program in Photograph Conservation, 2003, Unpublished

<sup>2</sup> Consortium Meeting Agenda (See appendix)

<sup>3</sup> Digital Documentation Program for Southworth & Hawes (In progress)

<sup>4</sup> Barger, Susan M. and William B. White, *The Daguerreotype: Nineteenth Century Technology and Modern Science*. Baltimore and London: The Johns Hopkins University Press, 1991

<sup>5</sup> A-D Indicators, product literature and product available from Image Permanence Institute *User Guide to A-D Strips*: Rochester Institute of Technology.

<sup>6</sup> Muller, Chris “Results of Silver Reactivity Monitoring in Preservation Environments”

<sup>7</sup> Muller, Chris, “ A New Standard for Environmental Assessments in Preservation Environments” (See appendix)

<sup>8</sup> Baboian, R., Electrochemical and Corrosion Laboratory, Texas Instruments, Inc. “Chapter 70 – Electronics” web publication: [www.corrosionsource.com/events/intercorr/baboian.htm](http://www.corrosionsource.com/events/intercorr/baboian.htm)

<sup>9</sup> NOAA; National Oceanic & Atmospheric Administration; [www.NOAA.gov](http://www.NOAA.gov)

<sup>10</sup> 3M™ Product data sheet: 427 Foil Tape (see appendix)

<sup>11</sup> Image Permanence Institute Protocol on Photographic Activity Testing Program

<sup>12</sup> Handbook of Chemistry & Physics, 83rd edition, CRC Press 2001, New York, New York