

# GUIDELINES FOR THE CARE OF WORKS ON PAPER WITH CELLULOSE ACETATE LAMINATION

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Laminated papers, present in archives across the country, may pose serious problems for archival collections. Lamination was a popular preservation method, adopted by many institutions handling large collections of archival materials. First introduced in the 1930s, lamination quickly became the primary choice for repairing and strengthening papers on a large scale. Now, however, conservators recognize that the materials used in lamination may degrade, damaging the very objects the process was intended to preserve. This paper —

- Explains the major problems associated with lamination
- Provides a key to determining if a collection includes laminated papers
- Describes how to assess the condition of laminated objects
- Outlines steps that archivists and collection managers can take to reduce risks to their collections
- Provides a [list of resources](#) for further study
- Provides a [glossary of lamination terms](#)

## ■ What is lamination?

Lamination is a method of strengthening fragile papers. Less time-consuming than traditional methods, lamination was widely used by archives from the 1930s through the 1970s. The lamination process involved deacidifying a document, layering it between tissue and thin sheets of plastic, and fusing them together in a heated press.

In archival contexts, lamination refers to the process of fusing a sheet of paper between two thin sheets of plastic — usually cellulose acetate. The archival community embraced lamination in the early 1930s as a means of strengthening fragile papers. It provided stability for weak or damaged documents in less time than traditional methods, making it cost-effective for large collections. Collections were often laminated before microfilming, to facilitate rapid handling. Lamination was also seen as a means of preventing damage from environmental contaminants and grime from handling.

The National Archives, the Library of Congress, and other organizations with large collections-- and budgets large enough to afford the equipment — began lamination projects in earnest by the late 1930s and 1940s. Institutions or organizations lacking the resources to acquire their own equipment often contracted the work to these other agencies. Lamination was recommended initially for records of little intrinsic historical

importance, but it was soon applied indiscriminately. Publications of the era described lamination as a panacea, and even such priceless documents as the Emancipation Proclamation were laminated.

As the lamination process was developed, numerous inventors and scientists — most notably William Barrow — experimented with ways to refine the technique. The National Bureau of Standards eventually made an attempt to standardize lamination, recommending a process with several stages. First, the document was to be deacidified, neutralizing the potentially damaging acids inherent in some paper. Next, the document was layered between thin sheets of a plastic — usually cellulose acetate — and tissue. The use of a plasticizer in the cellulose acetate increased the flexibility of the otherwise brittle plastic, as well as decreasing the temperature required to soften it. The addition of a thin layer of Japanese tissue on top of the cellulose acetate film greatly improved the tensile strength, internal tear resistance, and folding endurance of laminated documents. It also reduced the shiny appearance of the plastic laminate. Finally, the five-layer "sandwich" of materials was placed into a heated laminating press. The heat melted the plastic layer, while the high pressure forced the cellulose acetate into the interstices of the paper itself, sealing the document within a semi-flexible plastic coating.

Despite the National Bureau of Standards' attempt to standardize this lamination process, there was considerable variation in technique and in materials. Each laboratory generally retained its own protocols, and the process often boiled down to an individual operator's or technician's choice of what functioned well.

## ■ Why is lamination a problem?

The push for lamination was a well-intentioned attempt to address the condition of many fragile historic documents, but we now know that lamination was not the cure-all that librarians and archivists had envisioned. In fact, lamination may cause numerous problems for collections.

### ***Damage from the lamination process.***

The first problem associated with lamination is damage caused by the lamination process itself. The application of heat and pressure during lamination was sometimes poorly controlled, resulting in burned or scorched papers. High temperatures caused some media to melt or bleed, damaging wax seals, discoloring pigments, or blurring lines (Figure 1). Other media may have been partially solubilized — that is, some pigments or inks may have run or smeared (Figure 2) due to a chemical reaction during the lamination process.

***Aesthetic problems.*** In addition, laminated documents often have aesthetic problems. The cellulose acetate laminate greatly alters the appearance and texture of documents, giving the paper a shiny surface with an uncharacteristic hard, plastic feel. The addition of tissue in the laminating process helped reduce the shine, but unfortunately also reduced the clarity of the original documents, altering their colors and appearance. The different kinds of presses used to apply pressure during the lamination process produced a variety of new surface textures on the documents. The overall result is a hazy look (Figure 3) that one curator has likened to the appearance of plastic placemats. In other cases, the laminate renders documents



translucent; writing or images on the back of a page may show through, making them difficult to see.

**Figure 3.** The washed out hazy look of this drawing is due to the laminate and the tissue layer that were placed directly on the drawing. Battle of the Little Bighorn, 1881.



**Figure 1.** Detail of a wax seal after lamination. Source: 18th century land grants from the Pennsylvania State Archives.



**Figure 2.** Drawing with media that bled during the lamination process. Note that only the purple pigment is affected. Drawing by Charles Murphy (Bear Wings), Cheyenne. James Mooney Notebooks 1903-04.



**Figure 4.** This paper, already fragile before lamination, has become even more yellowed and brittle after being sealed between sheets of laminate. Drawing by Carl Sweezy (Arapaho). James Mooney Notebooks 1903-04.

Drawing by Red Horse (Dakota).

**Inherent vice.** Lamination may also exacerbate problems that were already present in the documents themselves (inherent vice). If, for example, a document on poor quality paper was not deacidified prior to lamination, the layers of plastic encasing the item may trap acids within the laminate, causing the paper to yellow and become brittle (Figure 4). In other cases, torn documents were repaired using inappropriate methods before they were laminated. Repairs with pressure-sensitive tape, for example, are potentially damaging for any papers, but lamination exacerbates the problem; the heat used in the lamination process can kick off chemical reactions, while the carefully sealed layers of laminate trap by-products, creating a harmful microclimate for the paper. Encased in plastic, these damaging repairs may be difficult for conservators to treat.

***Deterioration of the laminate.***

Deterioration of the materials used in lamination may cause additional damage to laminated documents. Remember that the lamination process drives the plastic laminate into the paper itself. When the plastic begins to break down, the document it encases will also suffer. The most widely used laminate, cellulose acetate, is inherently unstable. Like the cellulose acetate film base used in movies, the laminate decomposes through a chemical reaction that causes the bonds of the cellulose acetate molecule to break down. This decay process releases acetic acid from the molecule, producing the strong vinegar or ammonia odor that is called vinegar syndrome. As the laminate deteriorates, it may warp, stretch, or peel, placing great stress on the paper (Figure 5). In some cases, the stresses from deteriorating laminate are literally splitting the paper apart internally.

As cellulose acetate breaks down, it may exude plasticizers, the chemicals added to increase the flexibility of the otherwise-brittle film. Plasticizers exuded as a liquid may collect on the surface of the laminate, giving it an oily appearance and often



**Figure 5.** The wrinkling of this laminate may place great stresses on the paper enclosed within it. This image also shows the high surface gloss and surface texture that may be present on laminated papers. 18th century land grant from the Pennsylvania State Archives



**Figure 6.** Example of blocked papers, where sheets are stuck together; a conservator uses a teflon spatula to gently separate the leaves. 18th century land grants from the Pennsylvania State Archives



**Figure 7.** This page was chipped and torn when it was laminated. The white tab, at the left, was added after lamination in order to place the sheet in a post binder. Such binding places great stress at the already torn left margin of the page. Drawings of Eskimo scenes, 1895? By Guy Kakarook

leaving the surface quite sticky. When exuding leaves of laminated papers come into contact with each other, they may stick together in a block (Figure 6), making them unusable. The degradation of plasticizers also reduces the flexibility of the laminate itself; as this happens, documents are in danger of cracking, chipping, or completely snapping apart. This is particularly troublesome with laminated leaves that have been put in post bindings-- a common method of binding that places considerable stress on the bound edge of vulnerable documents (Figure 7).

***Secondary damage to neighboring objects.*** The most alarming aspect of the problem is that unstable laminate and plasticizers do not just affect single documents. As the materials degrade, they are capable of triggering chemical reactions in any nearby objects that are also made of cellulose acetate-- including previously stable laminated papers, photographic negatives, and motion picture film. Once this degradation process begins, damage will only become worse through time, unless properly treated.

[Continue to Part Two:  
Identifying and Assessing Laminated Papers »](#)

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