

Buffered and Unbuffered Storage Materials

Storing museum objects in archival-quality materials is essential for their long-term preservation. The housing enclosures used to store objects are usually in prolonged and direct contact with the object and form its immediate environment. It is essential that enclosures be made of archival-quality materials that are chemically stable. These enclosures also help to organize the collections; protect objects from light, dust, dirt, air pollutants, and handling; and provide some protection against sudden changes in temperature and relative humidity.

Paper products used for housing museum collections are available in a wide variety of types and sizes. Folders, envelopes, tissue paper, board, album pages, trays, and boxes are some of the many commercial paper products that are used in parks to house, store, display, and pack museum collections.

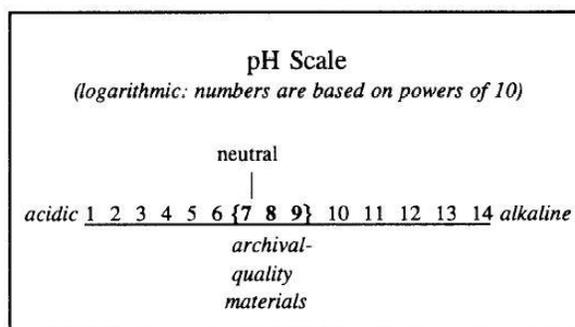
Paper was initially made by hand from rag (cotton or linen) which produced a strong, long-fibered paper. Since the 19th century, paper-making processes have produced inexpensive paper made from wood fiber. Most paper made from wood fibers contains lignin, which holds cellulose fibers together in the tree. Over time lignin deteriorates and produces acid that breaks down and weakens the paper. In addition, some paper is treated with alum-rosin sizing to control water absorption. This sizing produces sulfuric acid that can accelerate the deterioration process. Not only will poor-quality paper deteriorate but the acid produced during the deterioration process can migrate and contaminate the materials in contact with it.

Paper made from wood pulp can be chemically purified to remove acid-producing properties, resulting in a more stable paper. Over time, however, the residual chemicals

used to purify paper, those used to improve the appearance of paper (for example, bleaching agents), and air pollutants can cause acids to form which may migrate to the object inside.

The term *acid-free* is generally used to describe the paper products recommended for object, archival, and manuscript storage. Paper that is pH 7 or higher is considered acid free. Longer-lived acid-free papers are made with alpha cellulose stock and have little or no lignin.

The pH scale (below) measures the most acidic (pH 1) to the most alkaline (pH 14) with pH 7 being neutral.



Buffered Paper

Buffered paper products have an alkaline reserve, or buffering agent, added during production to alter the pH. Buffering protects the museum object against migrating acids. Calcium carbonate and magnesium carbonate are the common buffering agents. Because this alkaline reserve depletes over time, storage containers that were once acid-free can become acidic. Buffered paper is alkaline at about 7.5 to 8.5 pH.

Unbuffered and Neutral Paper

Unbuffered acid-free paper products are neutral or slightly alkaline but do not contain an alkaline reserve. *Neutral paper has a pH of 7-7.5*, and does not contain acid. It has a limited capacity to absorb acids from the environment or from objects housed inside, whereas alkaline buffered materials can help neutralize acids as they form.

Unbuffered acid-free paper is pH neutral at the time of manufacture; however, the pH value will drop when exposed to normal atmospheric conditions.

NOTE: Most objects can be safely housed in unbuffered neutral pH material (exceptions are listed in the table). *When in doubt about the type of enclosure or container to use, an unbuffered neutral pH enclosure is recommended.*

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The reference to NPS in this article stands for National
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Object Type	Buffered Materials	Unbuffered Materials	Remarks
Archeological Materials		Depending on the objects, many are housed in plastic such as polyethylene and polypropylene; use unbuffered tissue if padding is needed.	Buffered is not recommended because of the possibility of influencing research chemical analysis by placing object in an alkaline environment. <i>See NPS, Museum Handbook, Part I unbuffered tissue if (Rev 9/90), Appendix I, for storage guidelines.</i>
Archival & Library	Books, damaged or rare Flat documents Manuscripts Maps Most Papers (exceptions listed under unbuffered) Posters	Albums and collages with wool or silk components Blueprints Diaz reproductions Handtinted materials (maps) Friable media should be stored in shallow boxes (charcoal, pastels)	Buffered materials are preferable for storage of archival items with exceptions listed at left under Unbuffered. Buffered materials can alter the pigment color, so when storing handtinted or other color friable media mounted on acidic board, place in unbuffered pH neutral enclosure with a slip sheet of buffered next to the acidic board.
Archival & Library: Photographic Materials	Cellulose-nitrate and acetate and early safety film negatives. NOTE: Cellulose-nitrate is a fire hazard. The NPS policy for preserving it is by duplicating it onto safety film and storing the original in an appropriate storage facility. <i>See NPS Museum Handbook, Part I (Rev 9/90), Appendix M, Curatorial Care of Cellulose Nitrate Negatives.</i>	Monochrome processes, including: Albumen prints Ambrotypes Collodion prints Cyanotypes Daguerreotypes Gelatin prints Glass negatives Lantern slides Palladian prints Platinum prints Salted paper Sunprints Color images and negatives, including: Chromogenic photographs Dye transfer prints Polaroid prints	Current research indicates that buffered enclosures housing salted paper, albumen, gelatin, platinum and collodion-processed prints are not detrimental provided RH levels are maintained. It is not necessary to replace present buffered enclosures with unbuffered materials for these media. Any materials used to store photographs should have passed the Photographic Activity Test (PAT).
Works of Art on Paper	Prints Drawings	Watercolors Handtinted prints, drawings and other art	

Object Type	Buffered Materials	Unbuffered Materials	Remarks
Ethnographic Materials	Cellulosic (plant-derived) materials: Bark Cotton Linen Paper Wood	Proteinaceous (animal derived) materials: Antler Quill Bone Silk Horn Skin Ivory Wool	Ethnographic objects are often complex and could contain materials sensitive to buffered environment. If in doubt, use unbuffered neutral pH materials. See also Remarks under Textiles below.
Film	Black/white motion picture film	Color motion picture film	NOTE: Cellulose nitrate film is a tire hazard. The NPS policy for its preservation is by duplicating it onto safety film and storing the original in an appropriate storage facility. See NPS Special Directive 93-2 "Preserving NPS Cellulose Nitrate Film Collections," and NPS Museum Handbook, Part I (Rev g/90), Appendix M, Curatorial Care of Cellulose Nitrate Negatives.
Metal		Silver (Use acid- and sulphur-free tissue for wrapping to prevent tarnish.) Iron, lead, and other metals	Heavy, stiff tissue may scratch some soft metal; use a soft, neutral pH tissue.
Natural History Specimens	Herbarium collections	Insects (pinning trays) Skeletal material Birds and mammals	Does not apply to wet specimens except for label (unbuffered).
Textiles		All Textiles	Many references recommend buffered for plant derived material (cotton, linen) and unbuffered for animal derived material (wool, silk). The NPS Harpers Ferry Center Division of Conservation recommends that all textiles be wrapped in soft, unbuffered, neutral pH tissue. This recommendation is not based on chemistry, but is offered as a means to eliminate confusion because there are many buffered tissues. Many have hard, sharp corners when folded or crumpled and are too heavy or stiff for some fabrics.