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Standards and Guidelines for Storage of Historic Artifacts

Environment

The preservation of a historic artifact or piece of artwork is dependent on the environment in which an object is stored. Temperatures above 75° F and relative humidity (RH) in excess of 60% provide suitable conditions for the growth of mold and will accelerate the corrosion of metals. At higher temperatures, deterioration occurs at a significantly faster rate. Although, there are optimal temperatures and RH values for specific collection materials, the standard most suitable for the average collection is: 68° F ($\pm 3^\circ$ F) and 50% RH ($\pm 3\%$). Chemically unstable materials such as silver gelatin photographic prints or cellulose nitrate flexible film will require storage temperatures well below 68° F and in the case of nitrate or acetate film cold storage, 0° F or lower, must be a considered.

The most important criterion is to maintain a constant non-fluctuating environment that is also economically feasible. An elevation in temperature will accelerate the rate of deterioration reactions in paper-based artifacts and even more so in photographic materials. Fluctuations in relative humidity can cause mechanical damage to the paper fibers in an object as they absorb and release moisture to the environment. This is especially true and evident in composite objects such as books, photographs or paintings, where the different materials respond at different rates to changes in humidity.

Light exposure, regardless of the source, should be kept to a minimum. Light damage is irreversible and cumulative effects will shorten the life span of the artifact. Short periods of exposure to high levels of light can be just as damaging to an object as long periods of exposure to low light levels. Visible light can fade colorants in books and artwork and especially damaging is ultra-violet (UV) radiation. Light levels on average should not exceed 30 foot-candles and UV levels should not exceed 75 microwatts per lumen. Fluorescent lights should be sleeved with UV filters and UV filtering film can be applied to windows to protect collections on exhibit. Materials sensitive to light should be illuminated by no more than 10 foot-candles, which is roughly equivalent to a 60 watt incandescent light bulb approximately 15 feet from the object. For exhibition purposes, visitors should be allowed to adjust their eyes to the environment, rather than raising light levels to accommodate the viewer.

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Archival Storage Enclosures

Choosing the correct storage enclosure to properly house a variety of artifacts can be a daunting endeavor. There are several factors that must be considered when choosing the correct storage enclosure:

- What type of material requires rehousing?
- Paper or plastic?
- If paper, buffered or unbuffered?
- If plastic, what type of plastic?
- Is horizontal storage preferable to vertical storage?
- Store boxed, filed or on open shelving?

The *American National Standard for Permanence of Paper for Publications and Documents in Libraries and Archives*, ANSI/NISO Z39.48-1992 (ISO 9706:1994), defines the term permanent as the "criteria for coated and uncoated paper that will last several hundred years without significant deterioration under normal use and storage conditions in libraries and archives." The use and understanding of this standard will assist with the choice of paper-based storage enclosures. Different standards exist for storage enclosures for photographic materials. *Imaging Materials-Photographic Processed Films, Plates and Papers--Filing Enclosures and Storage Containers*, ISO 18902:2001 (formerly ANSI IT9.2-1998), provides specifications for photographic material. Another standard that all enclosures used for photographic materials should meet is the *Photography--Photographic Activity Test*, ISO 14523:1999 (formerly ANSI IT9.16-1993). Storage enclosures for photographic media should meet both of the above-mentioned standards. The standards can be purchased from the International Organization for Standardization's [ISO Online catalogue](http://www.iso.org) at /www.iso.org. It is imperative that the objects in a collection be identified so the appropriate enclosure can be chosen to rehouse the artifact for storage.

Paper Enclosures

Paper artifacts and most photographic objects can be stored in paper-based enclosures meeting the archival standards mentioned above. Paper enclosures are breathable and can allow air or any other gaseous material to pass through the enclosure both toward and away from the artifact. 100% cotton or cotton/linen fiber content makes the ideal source material, but properly-processed chemical pulp which is chlorine- and lignin-free with a pH ranging from 7 (neutral) to a buffered 8.5 (alkaline) can be considered a second choice. Certain artifacts, including blue prints, cyanotypes, diazo prints, albumen photographs and color photographs, should be stored in pH neutral, non-buffered storage enclosures. All paper enclosures used for photographic



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materials should have passed the photographic activity test (PAT), which determines potential fading of silver halide images. Alkaline conditions can alter the colors of blue prints and cyanotypes, and pristine albumen prints have been known to discolor slightly in the highlight areas of the photographic image.

The benefits of using paper enclosures versus plastic are few but are noteworthy. Paper enclosures are porous and can be buffered to contain an alkaline reserve to help neutralize the formation of acid compounds released by an object or protect it from acidic vapors in the immediate environment. The porosity of the paper enclosure may also benefit the object by preventing the accumulation of moisture vapor and/or the entrapment of harmful gases released by an object. An example of the beneficial use of paper enclosures is in the case of cellulose nitrate negative storage, where the nitrate film base has started to deteriorate and releasing acidic nitrogen oxide fumes. The nitrogen oxide gases, once released in the storage environment, can result in the accelerated deterioration of nearby objects. On the other hand, the opacity of paper can result in increased handling in order to view the stored objects. Paper enclosures can be more easily written upon with pencil to identify the contents of the enclosure.

Plastic Enclosures

There are three types of clear plastic enclosures that are stable and can be used for storing historic artifacts: polyester, polyethylene, and polypropylene. Polyester plastic enclosures are the most stable of the three, but all are appropriate for use as archival enclosures. Polyvinyl chloride (PVC) sleeves are not acceptable. PVC is a poor quality plastic material that contains plasticizers, or chemicals used to make the plastic film pliable. Plasticizers oxidize and deteriorate over time, and they can leach out of the plastic and cause severe deterioration, embrittlement, and fading of the objects stored in the sleeves. PVC is easily identified by its strong vinyl odor. If it smells like a plastic shower curtain, it is probably PVC and should be avoided.

Plastic enclosures allow one to view an object without directly touching it, thereby avoiding fingerprints and the transfer of oils and perspiration which can cause fading or discoloration. The non-porous nature of plastic enclosures can offer short-term protection from gaseous pollutants in the environment. Plastic enclosures tend to be more flexible than paper enclosures, and do not offer the same level of physical support. The plastic enclosure is also more difficult to write on and label. Plastics with melting points lower than the flash point of paper can melt from the heat of a fire and fuse to the artifact.



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Storage Method

Regardless of which enclosure material is used, all enclosure dimensions should be chosen to accommodate each artifact, providing adequate support and protection during handling. As the objects are sleeved, each sleeve or folder should provide an adequate margin to protect the edges of the artifact. All sleeves or folders should be the same dimension according to its size within a group or category. For instance, if you have a collection of prints ranging in size from 7" x 9" to 8" x 12", you would choose a folder dimension that will accommodate the largest object plus an additional margin of an inch or two, in this case 10" x 13". All the folders should be the same size for a given group and the folder size should fit properly in the archival storage box so folders are immobilized. This will allow for the suitable housing of the artifacts preventing material from sliding around in the storage box resulting in damage.

Generally, horizontal storage is the orientation of choice but vertical storage can be used effectively if proper support is provided to prevent artifacts from slumping. Incorporating four-flap enclosures in place of a sleeve will give a pamphlet or small notebook the additional support required to stand up right in a vertical storage box. Single leaves are better off stored in a folder and placed in a horizontally designed storage box. If vertically formatted boxes are chosen, make sure the box is adequately filled, ensuring objects do not slump. If padding is required to fill extra space then closed cell polyethylene foam such as Ethafoam or Plastizote blocks can be cut to fill the voids. 100% rag mat board dividers can be used for extra rigidity between groupings and can be used to index categories within the box.

Once the objects are sleeved, placed in an archival storage folder and properly boxed, the archival storage box can be shelved on stable powder-coated metal storage units. Newly-made baked enamel storage equipment, if not properly cured, can off-gas, releasing solvent and formaldehyde fumes. Baked enamel, in general, has been replaced in favor of the solvent free powder-coating process for sealing metal surfaces. Properly cured vapor free baked enamel storage units can still be used but should be tested.

Vertical file cabinets can be implemented as well. Objects which fit in standard file folders can be sleeved, placed in archival folders then placed in archival hanging file folders for support. There should not be more than five to ten individually sleeved objects per folder and only one folder per hanging file folder. This method works well for small objects that must be accessed regularly.

For additional assistance with your storage needs, please feel free to contact the nearest ECS conservation facility.