NATIONAL PARK SERVICE
DEPARTMENT OF THE INTERIOR

Conserve O Gram

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Judging Permanence For Reformatting Projects: Paper And Inks

Many permanently valuable NPS documents such as correspondence, drawings, maps, plans, and reports were not produced using permanent and durable recording media. When selecting paper items for preservation duplication, items marked on the list below with a "–" are at highest risk and should have special priority for duplication. Document types marked with a "+" are lower priorities for reformatting as they tend to be more stable and durable. See *Conserve O Gram* 19/10, Reformatting for Preservation and Access: Prioritizing Materials for Duplication, for a full discussion of how to select materials for duplication. ***NOTE:*** Avoid using materials and processes marked "–" when producing new documents.

Paper

All permanently valuable original paper documents should be produced on lignin-free, high alpha-cellulose papers with a pH between 7.5 and 8.0, specifically those papers meeting the American National Standards Institute (ANSI) Standards[1] for permanent records. Below is a brief overview of the types of paper found in original documents:

+ ***Handmade paper:*** Most paper was hand-made before the mid-1800s. Early hand-made paper often has longer fibers, a water-mark, and no pronounced grain direction that makes it more likely to tear or fold in one direction than in another. Handmade paper often has one or more deckled (feathered) edges. Before 1850, most Western paper was made out of cotton or linen rags.

+ ***High rag content paper***: Before the mid-17th century, paper was made of long-fibered, high alpha-cellulose cotton and linen rags. Early rag papers were strong, stable, and durable with relatively few impurities. In the mid-17th century, damaging alum sizing was added to control bacteria and mold growth in paper. By 1680, shorter fiber rag papers were being produced due to the use of mechanical metal beaters to shred the rag fibers. By about 1775, damaging chlorine bleaches were added to rag papers to control the paper color. Acidic alum rosin sizing was introduced around 1840 to speed the papermaking process thus leading to even shorter-lived papers. Rag papers became less common after the introduction of wood pulp paper around 1850. Compared to rag paper, most wood pulp papers have much poorer chemical chemical and mechanical strength, durability, and stability.

– ***Ground or mechanical wood pulp paper:*** After 1850, most paper produced was machine-made paper with a high proportion of short-fibered and acidic wood pulp. Machine-made paper has a distinct grain and will tear or fold easily along the grain. Ground wood pulp papers are unstable and have a high lignin content. High lignin papers, even when buffered, have a short life and less strength. Lignin is light-sensitive, and breaks into acidic compounds as it ages. The use of additives, such as alum rosin sizing, bleach, sulphur dioxide, and others has made the paper significantly more acidic. Acidic paper lacks strength and can become very brittle. Contemporary ground wood pulp paper has a life of 50 years or less. Most contemporary paper used for correspondence, reports, and publications is ground wood pulp paper.

– ***Recycled paper:*** Although admirable environmentally, recycled paper has not proven reliable for paper records of lasting value. Neither strong nor durable, recycled paper has very short fibers, bleaches and additives, and very little strength. Since the beginning of papermaking, paper has been recycled; however, it only has been a major commercial endeavor for the last 20 years.

+ ***Buffered papers:*** Any sort of paper can be buffered, from strong and durable rag papers to weak and brittle wood pulp papers. Buffering is the addition of an alkaline reserve, usually calcium carbonate, to paper. The alkaline reserve gradually depletes over time. Adding buffering does not strengthen or lengthen short paper fibers or remove damaging lignin from paper. Buffering absorbs and neutralizes acids. Inappropriate buffering can damage some materials that are naturally acidic. For example, deacidifying acidic blueprints and/or cyanotypes or even placing them next to buffered paper can cause image fading.

  Select neutral pH materials if the use is uncertain. Longer fiber papers, like rag papers, have significantly more strength than wood pulp papers, which have shorter fibers. Ground wood pulp papers with a high lignin content, despite buffering, will have a relatively short life. Do not apply spray deacidification solutions to materials without talking to a conservator. Do not automatically place buffered paper next to acidic materials without determining if the media will be damaged. See the *Museum Handbook,* Part I, Appendix J for further guidance.

Inks, Dyes, Graphite, Pigments and Toners

To be permanent, colorants and binders of inks, dyes, pigments, and toners should contain carbon black or inorganic colored pigments and stable resins (for example, stable forms of polyesters, polymides, acrylics, phenolics). Printing and machine copying must produce strong bonds between inks or toners and paper surfaces.

+ ***Graphite or "lead" pencils:*** A natural form of carbon, graphite is stable, but prone to smearing, like all friable media.

+ ***Carbon inks:*** Widely used until the 19th century, purely carbon inks are permanent and non-damaging to paper. Relatively unaffected by light, carbon pigments are still available today for calligraphy and drawing.

– ***Iron gall inks:*** Widely used to write on parchment and vellum papers, acidic iron gall inks were common during the 17th-19th centuries. Acidic iron gall inks may produce a *lace or stencil effect* by actually eating into the paper until the actual sketch or words are eaten away, leaving a stencil. These inks were frequently used in fountain pens in the 1860s and for letterpress copy books in the 1870s. Copy these documents after stabilization by a conservator.

– ***Felt and fiber tip marker inks:*** Commonly available since the 1960s, these water and solvent soluble inks are prone to washing off if exposed to water and are quite light-sensitive. Permanent versions of these pens may be quite acidic.

– ***Aniline dye inks:*** Commonly available since the 1860s, acidic and impermanent aniline dye inks appear in many fountain pen inks.

– ***Ballpoint pen inks:*** First developed around 1930, ballpoint pen inks have changed over time from dyes dissolved in oil to glycol inks in solvent or water. These materials vary greatly in life although they are generally quite water-soluble.

+ ***Typewriter inks:*** During the last century, typewriter inks have been composed of a wide variety of dyes, pigments, solvents, and other substances. Varying in life and permanence, self-correcting typewriter ribbon inks tend to be the least permanent of these media.

+ ***Laser printer toners:*** Available for the last 20+ years, laser printer inks are stable, as long as the printer is properly adjusted so

that the toner fuses. ***NOTE:*** National Archives and Smithsonian Institution studies indicate that toner fusing should be tested by running a white glove over the document. If the glove shows any darkening because of toner, the toner is not fusing properly and the printer requires adjustment.

\+ ***Dot matrix printer ribbons:*** Available for the last 30 years, dot matrix printer ribbon-produced documents are generally long-lived and stable. Their life is equivalent to that of carbon copies. They are the only stable choice if an impact printer is needed to produce carbon duplicates.

\- ***Daisy wheel printed documents:*** Commonly available for the last 35 years, daisy wheel printed documents are short-lived and unstable media not recommended for archival storage.

\- ***Ink jet documents:*** These water-soluble, short-lived media produce documents that smear and run easily. They have been commonly available during the last quarter of the 20th century. ***NOTE:*** It is anticipated that pigments will be available within a year for use in ink jet printers. Using pigments instead of dyes will produce long-lived documents.

\- ***Ink pad ink:*** Most ink pad ink is not long-lived, although the concept of an ink pad is centuries old. The Library of Congress provides quality permanent and durable stamp pad/pen ink. ***NOTE:*** This ink is the best and most permanent ink available. Write the Library of Congress, National Preservation Program, LMG21, Washington, DC 20540 for a brochure and ordering information.

Common Copy and Duplicate Paper Document Technologies

Copy processes were developed to save writers from having to produce handwritten duplicates of their letters and notes. Most copy paper processes tend to be short lived.

\- ***Letterpress copy papers:*** Letterpress copy papers are thin, overbeaten papers that produced copies when used as blotters against freshly inked surfaces. Letterpress copies have surprising mechanical strength for their thinness. However, since acidic iron gall ink was frequently used to make the copies these copies are often in poor shape. They may look like stencils when the acidic ink has eaten away the paper. Letterpress copies were produced during the 17th-20th centuries, although they have become quite rare in the latter part of the 20th century.

\- ***Carbon paper copies:*** First developed in the 1870s, carbon papers are still used in typewriters to produce impact copies today. Carbon copy paper has been produced using a variety of media including carbon black with oil and naphtha; coal tar dyes in wax or oil; and mineral oils and similar materials. Paper bases for these mixtures have varied widely from excellent to poor.

\- ***Carbonless copy papers:*** These non-permanent papers utilized a wide variety of pressure and chemical systems to form copy images. These processes have been common in the latter half of the 20th century.

\+ ***Gelatin dye transfer copies:*** These stable photographic copies, sometimes called Verifax copies, were commonly produced on uncoated paper between 1952 and 1976. Their life is partially determined by their paper quality which ranged from excellent to very poor. They range in tone from a deep gray to a warm brownish tone.

\- ***Thermographic copies:*** Developed around 1950, these heat-sensitive papers are exposed to strong light during the production process. They darken in time with exposure to light or heat and tend to be brittle.

\+ ***Mimeographic copies:*** Produced most commonly between the 1880s and the 1960s

by using a stencil, these images can be almost any color and any quality of paper. Mimeographs on good quality paper are long-lived. Mimeograph copies are still occasionally produced today.

– ***Hectographic copies:*** Using a carbon master, the hectographic process produces up to 500 copies by the combined use of solvents and pressure. Also called dittos or speedographs, these copies were most commonly produced between the 19th century and the 1960s.

\+ ***Xerographic copies:*** Introduced in the early 1960s, xerographic copies (also known as electrostatic copies or photocopies) can be produced on many types of papers. If produced using a stable toner and acid-free paper, the image can be very stable. All xerographic copies require fusing with either heat or pressure. Inappropriately fused items have a very short life. (See *Conserve O Gram* 19/4, Archives: Preservation through Photocopying, and *Conserve O Gram* 19/7, Archives: Reference Photocopying.)

– ***Facsimile copies:*** First invented in the mid-19th century, the modern fax machine became popular in the United States in the early 1970s. Fax copies can be made with several different heat and/or chemical printing technologies, all of which are short-lived.

Note

1. American National Standards Institute (ANSI) Standards:

   ANSI D3290-76 - for bond and ledger paper which must be strong and durable with excellent erasing qualities.

   ANSI D3208-76 - for manifold papers (carbon tissue) which is a relatively flimsy translucent tissue paper often used as interleaving with carbon paper.

   ANSI D3301-74 - for file folders which were originally made from jute or manila hemp, hence "manila folders."

   ANSI D3458-75 - for xerographic copies from office copying machines.

   ANSI Z39.48-1984 - for printed paper for libraries

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