

MATERIALS INFORMATION and TECHNICAL RESOURCES for ARTISTS - Flexible Supports

There are pros and cons to all solid and flexible supports. Generally speaking, an ideal support will be able to withstand fluctuations in RH and temperature, possess an adequate level of absorbency and/or tooth, and will not become brittle or fragile with age.

One drawback that is often associated with flexible supports is that they are more susceptible to being damaged by physical contact (e.g. tears, impact cracks, punctures, etc.) In addition, flexible supports are more likely to respond to changes in the environment, giving rise to draws in the corners, an overall loss of tension, and other planar deformations. Such damages can lead to both short and long term condition issues and can affect the stability of the paint and ground layers. Because of these issues, artists are highly encouraged to affix protective backing boards to the reverse of their paintings.

Rigid supports, on the other hand, are less likely to withstand physical damage. Although some will still react to changes in the environment (e.g. warping, cracking, etc.), there are steps that artists can take to mitigate these problems. One such method is to adhere a fabric support over the face of the rigid panel. This allows the paint/ground layers to remain somewhat flexible should the rigid support exhibit warping and/or cracking. Rigid supports can also be cradled, particularly if they are large in size, to counteract possible warping or other types of planar deformations.

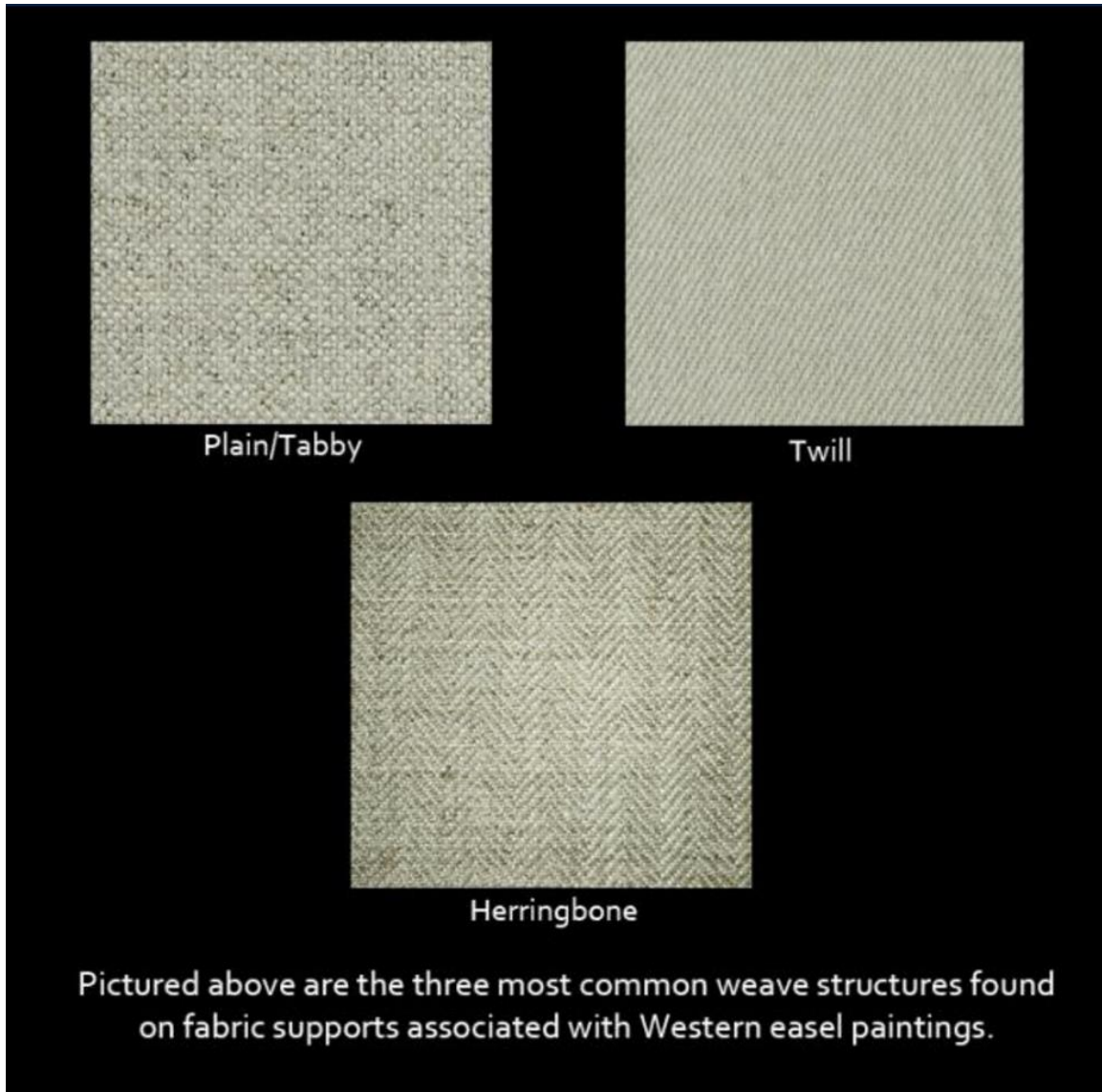
FLEXIBLE SUPPORTS

Canvas

The use of fabric supports for painting dates to Greek and Roman times. However, in the early modern times wood was the dominant support for easel paintings until the early 16th century. The lighter weight of a fabric support allows for easy transportation as well as the creation of large-format works. Some fabric supports such as canvas (a heavy, coarse, closely woven fabric) impart a texture which can still be seen even after the addition of the ground and paint layers. Many artists find this aesthetic effect appealing. Additional information on historical and contemporary practices relating to flexible supports is available in additional resources and references section.

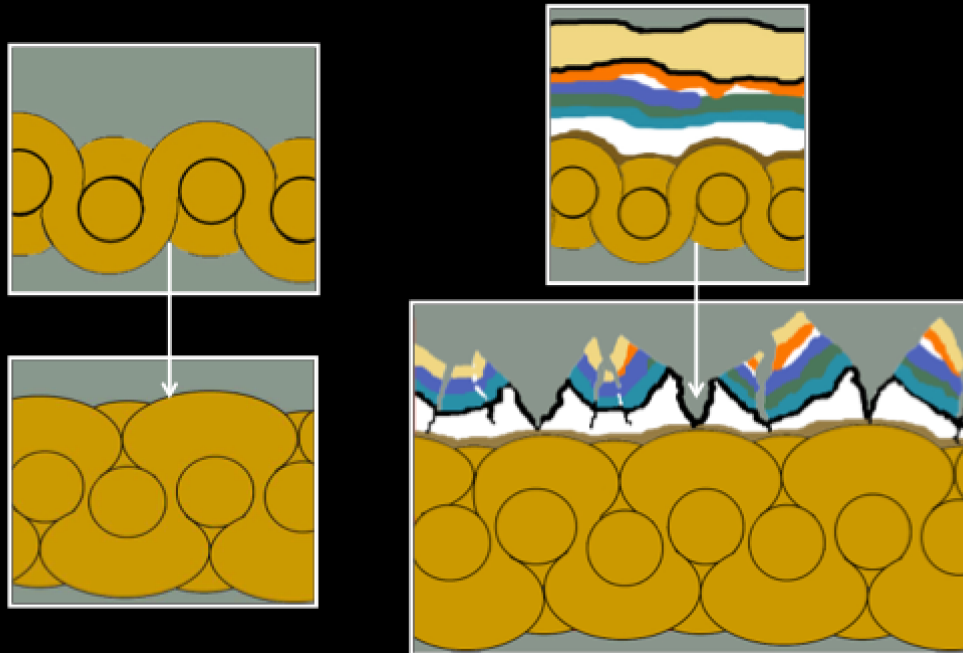
Until the later 19th century when cotton began to be used as a cheaper alternative, hemp and especially linen canvas fabrics were the most common types of fabric supports used in Western painting. Canvas strength is determined by the choice and quality of the fiber, the thickness of the thread, and the tightness of the weave. The weave of a canvas (or any other woven fabric) runs in two directions: the longitudinal **warp** yarns run the length of the fabric while the **weft** yarns run the width. Fabrics that are loosely woven are said to have an “open” weave, while those with closely compacted threads are usually described as tightly woven. The most

common weave structure --one in which the weft alternates over and under the warp-- is called "plain" or "tabby" weave. Other types of common weave structures include twill (the weft threads are woven over one and under two or more warp yarns, producing a characteristic diagonal pattern) and herringbone (a form of twill weave which resembles a broken zigzag).



In modern paintings executed on flexible supports, the canvas is typically stretched over an expandable auxiliary support (e.g. stretcher). However, it can also be adhered to almost any rigid substrate (e.g. wood, ACM). Stretched canvas supports made from natural fibers are sensitive to changes in humidity and temperature, absorbing and releasing moisture with those changes. In extreme circumstances, this can lead to cracking and delamination of the ground and paint layers.

Swelling of fibers and shrinking of canvas when it comes in contact with water or when the relative humidity exceeds 85%



Canvas is available in a variety of fabrics, including natural fiber fabrics (e.g. linen, cotton) and synthetic fabrics (e.g. woven polyesters, high density polyolefin like Tyvek). Both raw and pre-primed canvases are available. Canvases that are more tightly woven and not too thin possess the greatest structural integrity. All fabric supports should be taught on their auxiliary supports.

One should exercise caution when selecting commercially prepared supports as the quality of pre-primed canvases can be difficult to evaluate. If the ground layer is not well bound, there will be problems with adhesion and delamination. Artists should contact the manufacturer of a prepared canvas to find out if it has been sized and what type of size and ground were used. Grounds containing zinc white or any other zinc-containing materials are best avoided as they can become exceptionally brittle and cause issues with delamination and metal soap formation.

Auxiliary Supports for Paintings on Canvas - Stretchers and Strainers

A **stretcher** is a frame with expandable corners generally constructed from machine-made wooden rails with beveled edges. Each of the mitered/mortise-and-tenon corners of a stretcher (a mortise and tenon joint is one in which the rectangular end of one piece—the tenon-- fits into a rectangular hole of the same size—the mortise-- in the other piece) is outfitted with a wooden or plastic wedge called a “key.” Once a canvas has been attached to the stretcher, the keys can be

gently tapped to slightly expand the overall dimensions of the stretcher. This is called “keying out” and is done if the stretched fabric support becomes slack or develops slight planar deformations. Caution should be exercised when keying out a painting. If it is done too aggressively or in unsuitable environmental conditions, it can cause damage to the canvas support. A **strainer** is a chassis with rigid, *fixed* corners. Artists should consider avoiding strainers as long-term auxiliary supports as the rigid corners restrain the natural movement of the canvas support leading to cracking and/or flaking of the paint.

When artists choose stretched fabric supports they should consider the following:

- Acknowledge that natural fibers (e.g. linen) will respond more to changes in humidity/temperature than synthetic fibers (e.g. polyester).
- Consider mounting fabric supports onto rigid supports (using BEVA 371, pH neutral PVA adhesives, certain acrylic mediums, and other appropriate adhesives...see “Rigid Supports” document). Paintings on stretched fabric supports risk the possibility of being punctured or torn and react to fluctuations in the environment. Rigid secondary supports increase long term preservation.
- Choose fabrics with a close weave with warp and weft threads of an equal weight.
- Avoid “blends” - fabrics with warp threads of a different fiber than the weft threads (e.g. one cotton and the other polyester) -- as threads spun from different materials react differently to changes in the environment.
- Use auxiliary supports with expandable corners (stretchers) rather than those with fixed corners (strainers). Planar deformations in stretched canvases can occur as a result of cycles in temperature and humidity. Auxiliary supports with expandable corners make it easier to mitigate the deformations.
- Consider sealing wooden auxiliary supports to prevent absorption/expansion in response to changes in the environment (acrylic solutions like B-72 or MSA varnish, shellac, etc.). This sealing layer is even more important as it can also prevent certain chemicals from off-gassing and causing potential damage to the canvas.
- Consult a conservator when attempting to mitigate planar deformations on canvases that are exceptionally fragile and/or brittle.
- Know that it is possible to paint on a flexible support that has not first been stretched (e.g. a canvas can be worked on when tacked to a wall or to a large piece of plywood). When working in oil paints, do not let the paint film completely cure (it must retain some flexibility) before stretching or it may crack while being stretched. When working in acrylic dispersions, let the painting dry for a week or two before stretching.

- Eliminate any unwanted creases and folds in newly purchased canvas. One older method is to stretch the canvas support, wet the fabric, allow it to dry completely, and repeat the process. A variation on this method is to iron the canvas with a steam iron, then iron it with a dry iron, stretch the canvas, wet the canvas, allow it to dry, and adjust the tension if necessary. A newer method is to place the canvas face down on a blotter, mist the back in the areas where there are wrinkles, place another blotter and a sheet of glass on top, place weights (e.g. books) on top of the “sandwich”, and leave for twenty-four hours. Artists can also purchase an affordable hand-held steamer to use locally on less pronounced creases.
- One can choose to initially attach a canvas to its stretcher with heavy duty metal push pins so that early adjustments to the tension can be made without much difficulty (the push pins can be replaced later with more permanent tacks.)

Mylar/Polyester Films

“Mylar” is a registered trademark of the DuPont Company that refers to polyethylene terephthalate plastic (or PET). However, it is often used as a generic term for all polyester films. As Mylar was developed in the 1950s and is a relatively new product for artistic use, little information is available about the long-term properties of PET supports.

If artists choose to use Mylar and related polyester supports they should consider the following:

- Migration of additives within the polyester substrate (microscopic inert inorganic particles embedded in the PET to roughen the surface of the film so that it will not stick to other layers of film) may lead to problems of adhesion of ground and paint layers.
- Environmental fluctuations may cause ground and paint layers to expand and/or contract while not affecting the Mylar
- Accidental creases and planar deformations are often impossible to rectify.
- Polyester-based films should be mounted on, or positioned against, a solid substrate, framed behind glass/glazing, and stored or displayed in a stable environment.
- Frosted Mylar is preferable as it provides a mechanical tooth for the paint to adhere to.

Paper Supports

There are three things which determine the quality of a paper support: fiber type and length, manufacturing process, and pH (acidity/alkalinity). They are related to

one another as the raw material used during production and the manufacturing process influence the pH of the finished product. Artists might occasionally consider mounting paper supports onto rigid supports (using pH neutral PVA adhesives, certain acrylic mediums, and other appropriate adhesives). Mounting paper onto rigid secondary supports helps to promote long term preservation. A more common alternative is to choose the appropriate matting and/or framing system, a topic that can be further discussed on the MITRA forum.

Fiber Type

All paper is manufactured from cellulose fibers; however, the type of plant fiber can make a considerable difference. The strongest papers are made from plant cells which are high in cellulose and of the longest length; this makes for durable, stable fibers. There are countless fiber types available, but the majority of artists' papers fall into the following categories:

- **Wood pulp**, including ground wood and newsprint paper. Papers made from wood pulp contain lignin – a complex organic polymer that gives wood strength but becomes acidic in paper unless it is removed during manufacture. Acidity can also be a by-product of heavy metals and chemical residues from the bleaching and pulping processes. The majority of papers in everyday use are made from wood pulp, and as a result many of them are acidic.
- **Cotton fibers** produce the majority of rag papers today. Rag paper was originally named for the linen and cotton rags that were processed during paper manufacture. Rag paper today is generally composed of cotton linters, the shorter fibers left over from cotton thread manufacture; it is chemically and mechanically stable, and as a result is of excellent quality.
- **Other plant-based fibers** are also used (and have been used for centuries) to produce papers of high quality and stability. These include flax {linen}, ramie, the bark of various trees (such as mulberry), banana leaf, jute, straw, and the fibers of an almost endless array of plant material.

Paper Manufacture

The methods used to make paper affect the stability of the finished sheet, as pH and fiber strength are determined by the way in which the raw material is processed from pulp to finished sheet.

- **Handmade** paper is made the same way it has been for centuries, using a vat and screen. It is usually good quality, long-fibered paper.

- **Mold-made** paper is usually produced from quality fibers by a cylinder-mold machine. The majority of fine artists' papers are mold-made.
- **Machine-made** paper has three main types: mechanical pulp, chemical pulp, and machine-made permanent. It is produced by a Fourdrinier machine from wood fibers. Unless the manufacturer indicates otherwise, machine-made paper contains lignin and will degrade quickly. Chemical pulp papers are generally of better quality than mechanical pulp papers; they are often marketed as "wood free" paper. Although they are still made from wood pulp and are not as pure as machine-made permanent paper and mold-made paper, the lignin content is lower. In some cases, lignin can be completely removed chemically, leaving an acid-free, high-quality machine-made paper.
- **Machine-made permanent** paper is produced by a Fourdrinier machine from wood fibers, and the lignin has been removed through chemical processing. Paper which meets the standard for Permanent Paper will have a neutral pH, alkaline reserves, fibers from chemically processed wood pulp or rag fibers, and strong resistance to tearing and folding. It is of excellent quality and is generally used for printing archival records.
- **Bleaching and optical brighteners** are often used to increase the whiteness of paper which is not naturally bright enough for some purposes. However, if bleach is left in the fibers, paper can deteriorate. Paper treated with fluorescent bleaching agents in optical brighteners (which make paper appear to be whiter due to their absorption of UV light and re-emission of it as blue light) will eventually turn yellow and darken.

Paper pH

The pH of paper selected for stability should always be neutral (7) or alkaline (>7). Paper which is even slightly acidic will have already begun deteriorating by the time pH is measured.

- **Buffered** paper is manufactured with an alkaline reserve, or buffer. This is often (though not always) 3% calcium carbonate. The benefit to having this reserve is that it helps to keep the paper's pH alkaline long after manufacture. However, this alkaline reserve is not indefinite and eventually the sheet may become acidic. The pH at the time of manufacture is typically between 7.5 and 9.5.

- If paper isn't labeled "acid free," or this information needs to be verified, a pH pen or pH strips are an inexpensive way of testing this in the studio or at home.
- Note: paper which will come in direct contact with some photographic materials (color prints, albumen prints, and cyanotypes) should not be buffered, as these materials are sensitive to alkalinity.

Understanding Manufacturers' Terms and What They Mean (or Don't Mean)

When selecting paper for quality and stability, it can be very easy to get confused by the terminology used seemingly at random by manufacturers. However, knowing what these terms actually mean will help to avoid confusion while choosing paper.

If artists chose to use paper supports they should consider the following:

- **Acid-free** refers to papers which the manufacturer has determined to have a neutral pH (7) or an alkaline pH (>7). Acid-free paper products can, in theory, be composed of almost any fiber – from cotton rag to wood pulp, and many other things in between. However, because of wood pulp's acidic nature, this means that the finished sheet has must be buffered with an alkaline reserve (usually calcium carbonate) and/or has had the lignin content chemically removed or diminished. The term acid-free connotes material which is designed to remain stable over time, but the reality is that the acid-free label is only given at the time of manufacture. Having a buffer is also not a guarantee that the paper won't become acidic over time, as the alkaline reserve becomes depleted. This is where it helps to know what plant material the paper is composed of; certain materials and paper processes are inherently more stable than others (i.e. mold-made cotton papers, handmade mulberry papers).
- **Alpha-cellulose** refers to the class of cellulose that has the highest degree of polymerization and is the most stable. Papers with a high alpha-cellulose content include cotton, ramie, flax, and kozo (mulberry bark). Wood pulp can be used to produce alpha-cellulose fibers through chemical processing, as with machine-made permanent papers.
- **Archival** or **archival-quality** are terms which manufacturers originally used to designate a material which was suitable for long-term storage. However, over time these terms have been used indiscriminately to the point where they do not necessarily mean anything at all – don't be fooled by seeing them, unless the manufacturer has also included other information to identify pH and fiber content. A claim of being "archival" must also be supported by material content and pH information (i.e. 100% cotton, acid-free rag paper, for example).

- **Conservation-grade** originally referred to “acid-free” paper which was wood pulp-based and buffered. While it is better quality than some types of paper, it’s actually not truly suitable for conservation or long-term storage as the alkaline reserve may be depleted over time. Be aware that this term may also be used indiscriminately.
- **Permanent Paper** indicates that the paper meets standards for paper manufacturing, such as US ANSI/NISO Z39.48-1992 or ISO 9706. These standards establish criteria for manufacturers of paper, and for the production of coated and uncoated papers which will last for several hundred years. Standards cover pH value, tear resistance, alkaline reserve and lignin threshold. Paper which meets the standard for permanent paper will have an infinity symbol identification mark. Permanent paper is usually used for documents and printed material. Archival Permanent Paper is designated by ISO 11108 and is designed to be an especially durable, stable paper for “publications of high legal, historical, or significant value.”¹
- **Rag paper** is made of long fibers, usually cotton (but can also be composed of other materials). In general, it is strong, long-lasting, and of a superior quality to other papers, particularly for use in fine art. Most rag papers will be labeled “100% Cotton” or “100% Cotton Rag.” There is still a brand of paper that is made from a mix of fibers derived from both cotton and linen.

Compatibility Between Paper and Media

Long-term stability can also be affected by the compatibility between the media and substrate – paper type, ground media applied (if any), and the method of application all affect the way a work ages. Paper manufacturers will often indicate which of their paper products are compatible with various media. A thorough guide to use for matching media to paper is *Which Paper? A Guide to Choosing and Using Fine Papers for Artists, Craftspeople, and Designers* (1991) by Silvie Turner.

ADDITIONAL RESOURCES AND REFERENCES

General

“Supports” in *The Painter's Handbook: Revised and Expanded* by Mark David Gottsegen (New York: Watson-Guption, 2006), pp. 32-50.

Which Paper? A Guide to Choosing and Using Fine Papers for Artists, Craftspeople, and Designers by Silvie Turner (New York: Design Books, 1991).

¹ Hoel, I. “Standards For Permanent Paper.” 64th IFLA General Conference – Conference Programme and Proceedings. Retrieved from archive.ifla.org.

“History of Fabric Supports” by Christina Young and Alexander W. Katlan in *The Conservation of Easel Paintings*, eds. Dr. Joyce Hill Stoner and Rebecca Rushfield (London and New York: Routledge, 2012).

Natural Pigments – Adhering Canvas to Panel Adhering canvas to board
<http://www.naturalpigments.com/forum/preparing-canvas-panels-painting/?p=1>

Golden Artist Colors - Preparing a Painting Support
http://www.goldenpaints.com/technicalinfo_prepsupp

CAMEO: Conservation and Art Materials Encyclopedia Online (Museum of Fine Arts Boston) http://cameo.mfa.org/wiki/Main_Page

Canvas

Kress Technical Art History Website – General Information on Fabric Supports
<https://www.artcons.udel.edu/about-us/kress/historical-materials-techniques/fabric-supports>

Winsor & Newton – Understanding the Difference between Canvas and Linen -
<http://www.winsornewton.com/na/discover/tips-and-techniques/other-tips-and-techniques/difference-between-canvas-and-linen>

Natural Pigments – Canvas Supports <http://www.naturalpigments.com/art-supply-education/canvas-supports-painting>

Golden Artist Colors – Stretching Canvases <http://www.justpaint.org/a-remarkable-way-to-stretch-canvas-and-other-essentials-of-canvas-preparation/>

Golden Artist Colors – Stretchers and Strainers
<http://oldsite.goldenpaints.com/justpaint/jp17article3.php>

Mylar

Abbey Newsletter - Conservation Information on Mylar <http://cool.conservation-us.org/byorg/abbey/an/an13/an13-5/an13-507.html>

Golden Artist Colors – Acrylics on Plastics <http://www.justpaint.org/acrylics-on-plastics>

OS Graphics – Substrate List <http://www.sosgraphics.ca/SOSMaterialList.pdf>

Paper

American Institute for Conservation (AIC) Book and Paper Group - "Big Paper, Big Problems: Rigid Support Options for the Mounting and Display of Large Format Works on Paper" by Michelle Facini and Stephanie Lussier

<http://cool.conservation-us.org/coolaic/sg/bpg/annual/v22/bp22-22.pdf>

Glossary of Paper Terminology <http://www.glatfelter.com/learning/glossary.aspx>

Philadelphia Museum of Art – Descriptive Terminology for Works of Art on Paper

http://www.philamuseum.org/doc_downloads/conservation/DescriptiveTerminologyforArtonPaper.pdf

Library of Congress - Summary of paper-making history and preservation topics

<https://www.loc.gov/preservation/care/deterioratebrochure.html>

Preventive Care of Graphic Art on Paper. Cornell University Library (Ithaca: Cornell University, 2001).

Matting and Hinging of Works of Art on Paper, by Merrily A. Smith and Margaret P. Brown (New York: Consultant Press, 1991).

Papermaking: The History and Technique of an Ancient Craft, by Hunter Dard (Reprint, 1947; New York: Dover Publications, 1978).