Basic Textile Care: Structure, Storage, and Display

Elizabeth Bittner

INF 392E
Introduction to the Structure and Technology of Records Materials
Pavelka
Fall 2004

This paper can also be accessed online at:
http://webspace.utexas.edu/ecb82/textile_care.doc
Introduction

Textiles have been used in various human endeavors for thousands of years and have the potential to be highly symbolic and culturally important. This is especially true in the United States where even mundane textiles such as handkerchiefs and bandannas have held political and cultural significance (Collins, 1979). Due to this intimate link with historical events, items such as flags, campaign banners and bandannas, pennants, and other flat textiles stand a reasonable chance of being included in library, archive, or museum collections.

Ideally, a textile conservator should be consulted in the care and repair of a historic textile; however, this is not always immediately possible because of budgetary concerns or a lack of local or in-house specialists. In some cases, the cost of a conservator’s services may greatly exceed the monetary value of the piece (Finch and Putnam, 1985). When professional repair services are unavailable or impractical, preservation should be the focus as “the first and safest line of defense against all the causes and some of the effects of deterioration” (ibid. p. 9). To this end, this paper offers a brief overview of the structure, storage, and display of flat textiles for libraries, archives, museums, and private collectors who may not have much experience in textile care and who lack immediate access to professional textile conservation services.

What is a Textile?

The term textile can be applied to several types of materials under a couple of related definitions. The most basic definition of a textile is a material that has been fabricated by some type of weaving process. This definition is derived from the Latin root of the work “textile,” textere, which means “to weave.” The term textile can also be applied to materials manufactured by the interlacing of yarn-like materials, such as objects made by braiding, knitting, and lacing, as well as some non-yarn based materials, such as felts, in which the fibres have gained coherence by mechanical treatments or chemical processes. In rare cases, pelts, hides, and plastics may also be considered textiles, especially when they are used in the manufacture of clothing items (Leene, 1972).

Textile Fibres

All textiles are made of fibres, that are technically defined as “a unit of matter with a length at least 100 times its diameter, a structure of long chain molecules having a definite preferred orientation, a diameter of 10-200 microns, and flexibility” (Landi, 1998, p. 8). Variations in fibres on both the microscopic and the visible levels can have a great impact on the behavior and deterioration of a textile object, and learning the basic properties of textiles can greatly aid in caring for them. There are three major factors that determine the final characteristics of any textile- the fibre form, the source of the fibre, and the method of constructing the final product (Landi, 1998).

Fibre Sources and Forms

Fibres come in one of two forms based on the length of the fibre. A filament is a fibre of continuous length. Both natural and man made filaments can be extremely long. Silk worm cocoons, for example, can contain about two miles of continuous twin filaments, and man made filaments from spinning machines can be even longer. Filament yarns are typically thin, smooth, and lustrous. A staple, on the other hand, is a fibre of
limited length ranging from about one-quarter of an inch to many inches in length. Staple fibre yarns tend to be thicker, fibrous, and non-lustrous. (Miller, 1969).

There are three categories of fibres based on source: natural fibers, mineral fibers, and man-made fibers. Mineral fibers include glass and asbestos and are normally not directly involved in textile production so only the natural and man-made fibers will be discussed here. All natural and man-made fibers on a microscopic level are built of organic polymers, large carbon-based molecules composed of a single unit repeated many times. Different types of polymers result in different fiber, and eventually different textile characteristics (Landi, 1998).

**Natural Fibres**

Among the natural fibers, silk and wool come from animal sources while the common vegetable sources are cotton and flax (Landi, 1998 and Miller, 1969). The silkworm, *Bombyx mori*, produces silk fibers when it spins a cocoon to protect itself in the pupa stage (Finch and Putnam, 1985). The fibers are constructed from amino acids that are cross-linked and generally oriented parallel to the fiber axis. This is referred to as a crystalline chain structure, and this structure is responsible for the strength of silk fibers.

Wool fibers are also constructed of amino acids except they are arranged into long helical (spiral shaped) molecules making wool much more extensible than silk (Landi, 1998). The fibers, because of this structure, also tend to shrink and mat together when washed in hot, soapy water. This is referred to as felting (Miller, 1969). Wool fibers, like human hairs, are difficult to press into sharp folds, and permanent folds can only be achieved through chemical processes. The natural function of wool is to keep the animal on which it grows dry. Even when incorporated into a textile object, wool fibers retain the ability to absorb up to one-third of their own weight in water before feeling damp to the touch (Finch and Putnam, 1985).

Vegetable fibers are constructed of cellulose polymers which join together to form long, flexible, and very strong long-chain molecules (Landi, 1998). The function of flax is to hold the flax plant upright and carry moisture through the plant, thus linen (fabric that is made from flax fibers) will have a tendency to draw moisture to itself. Cotton fibers come from the seed heads of the cotton plant and surround the seed before it drops. Both cotton and flax are stronger when wet and humidity is a requirement for weaving cotton fibers (Finch and Putnam, 1985).

**Man-Made and Metal Fibres**

Man-made fibers were first developed in an attempt to make artificial silk, and typically have a high degree of crystallinity like silk. While no true substitutes for silk were ever developed, the research did lead to the development of several types of man-made fibers that can be produced via various chemical processes. These fibers can be divided into two categories: regenerated fibers and synthetic fibers.

Regenerated fibers are made from natural materials that have been dissolved and then extruded as filaments. Regenerated fibers made from cellulose, commonly termed rayon, have become the most commercially important. Synthetic fibers include polyamides (commonly known as nylons), polyesters, and polyvinyls (Landi, 1998 and Miller, 1969).

Metal can also be fashioned into a filament-like form and used in textiles. Consequently, metal threads are sometimes classified as a type of fiber. Gold and silver
alloyed with baser metals such as copper are the most common materials used for metal thread production. The metal is beaten or drawn into very thin laminates and usually wound around a central fibre core that can either be silk, linen, or, in rare cases, cotton. Sometimes the laminate is attached to paper or an animal membrane before it is used. Metal fibres are typically more resistant to deterioration than organic fibres and are often the only intact parts of very ancient textiles (Landi, 1998).

From Fibre to Fabric

**Yarn Based Structures**

In all fabrics except bonded fabrics and felt, fibres are twisted into thicker structures called *yarns or threads* before being used. The process of creating yarns is called *spinning*. Yarns can be spun in either the clockwise or counter-clockwise direction. One direction is termed the Z direction and one is termed the S direction. After the initial yarn is spun, several yarns can then be twisted together to form ply yarns (i.e. two ply, three ply). These types of yarns are typically thicker and stronger than single ply yarns (Landi, 1998).

Yarns can be woven, knitted, braided, and laced or netted to create fabric. Each type of structure has an effect on the elasticity and durability of the final product. Diagrams of the different structures are provided in Appendix A. Woven fabrics consist of two series of threads that are interlaced at right angles to one another. The two thread series are termed the *warp* and the *weft*, with the warp threads running the length of the fabric and the weft threads running the width of the fabric. The simplest form of weaving, plain weave, is shown in figure 1 of Appendix A. The edge on the long sides of a piece of woven fabric is termed the *selvedge*. The selvedge provides a neat edge to the fabric as well as a secure grip for finishing machinery in machine made fabric. It is often different in appearance and structure to the rest of the fabric. Depending on the method of weaving, the density and type of interlacing can vary, both of which affect the final appearance and handle of the fabric. In general, no matter what method of weaving is used, the fabric will show little capacity for stretching beyond the natural elasticity of the materials in either the warp or weft direction. Instead, a woven piece of fabric will stretch more easily in the bias direction, the diagonal of the fabric that is normally at a forty-five degree angle between the warp and the weft.

Knitted structures are formed by interlocking loops of yarn, and, like weaving, there are several methods of knitting fabrics. A weft-knitted structure, so termed because it is constructed of horizontal rows of loops that are individually locked with the corresponding loop in the next horizontal row, is shown in figure 2 of Appendix A. Vertical rows of interlocked loops are termed *wales* and horizontal rows are termed *courses*. Knitted fabrics are much more susceptible to stretching and distortion than woven fabrics because any tension exerted on the fabric will distort the individual loops that form the fabric. Knitted fabrics are also easily unraveled, and significant damage can be caused by simply breaking one loop that, in turn, causes other loops to be released.

Lacing and netting were formerly hand techniques in which yarns are twined or knotted around each other to form various open structures. Now most lace and netting is made by machine. A simple net structure is shown in figure 3 of Appendix A. Items made by lacing and netting are even more dimensionally unstable than knitted fabrics are (Miller, 1969) and the uses of such fabrics are limited; however, several types of banners
were constructed with net bases in the nineteenth century. Advertisements for such banners can be seen in figure 4 of Appendix A (Collins, 1979).

Braiding involves the interlacing of yarns diagonally to form a narrow flat or tubular structure. A typical braid is illustrated in figure 5 of Appendix A. It is difficult to form large braided pieces either by hand or by machine due to the fact that all the constituent yarns must be kept in motion simultaneously and separately. Shoe laces and other kinds of cording as well as decorative braiding are common braided products. The diagonal direction of the yarns allows braids to be somewhat extensible in length and width (Miller, 1969).

**Fibre Based Structures**

Under the influence of heat, moisture, and mechanical pressure some types of fibre can be made to mat together to form fabric without the need for yarn. Fabrics made in this way are called felts. Wool and a few other animal fibres are most suited to this type of fabric construction. Felt fabrics have no grain because the fibres do not lie in any particular direction, and because of this, felt can be cut in any direction without fraying or unraveling. Dense felts can be very strong and durable, but are generally stiff and do not drape well. Softer and suppler felts result from less dense fiber structures but there is also a loss of strength and a vulnerability to distortion associated with thinner felts that makes them unsuitable for most purposes (Miller, 1969). Pennants are a common type of historical felt textile in the United States (Collins, 1979).

Fibres other than wool can also be bonded together through chemical rather than mechanical processes. These types of fabrics are referred to as bonded fibre fabrics. Bonded fibre fabrics are similar in structure to felt, although some types can be made with the majority of the fibres lying in one direction creating a fabric with a noticeable grain. Bonded fibre research has not, however, been able to overcome the suppleness and durability problems shared with felt (Miller, 1969).

**Textile Finishes**

Any given textile will probably undergo one or more finishing processes before it is used and many processes have been in use for hundreds of years. These processes are too numerous to list here, but they all serve at least one of the following purposes-

- to enhance the appearance of the fabric
- to improve the texture or weight
- to increase flexibility, durability, or ease of care

Finishing processes can be carried out either before or after the textile construction process. Mercerizing, sizing, and weighing are some examples of finishing processes that have been widely used for several centuries (Landi, 1998). Mercerizing is a finishing technique used on cotton yarn and cloth. Various concentrations of sodium hydroxide, an alkali substance, are applied to make the finished textile piece more lustrous, stronger, more absorbent, and easier to dye. Sizing is also a finishing technique for cotton. Gelatin sizing can be used to give the cotton a coated a papery look, and animal glue sizing made from fish skins can be used to give a greater luster (King, 1985).

Weighting is “the process of loading either yarns or fabric with minerals, sugar, or other foreign matters mixed with the dyes, to make the goods look thick or feel heavy” (King, 1985, p.173). In silks this finish compensates for the loss of the natural compound sericin which is lost during the manufacturing process (Finch and Putnam, 1985). Other
finishing methods were also used on silks to make lower quality silks appear more costly. These finishes employed gum, starch, oil, and wax based materials, most of which will not withstand washing (King, 1985).

Dyeing is another of the more common finishes with certain dyes becoming more popular during certain periods. Early bandannas are often referred to as “turkey red” bandannas because they were dyed a solid red color before a pattern was applied via bleaching or printing. Figure 6 in Appendix A is an example of this technique (Collins, 1979). Early dyes were obtained from natural sources and varied greatly in quality and ease of use. In 1856, W.H. Perkin, a British scientist discovered the first synthetic dye by accident and this lead to the development of a wide range of synthetic dyes that eventually replaced natural dyes. Even with synthetic dyes, however, dying is a difficult and complicated process due to the fact that many dyes on their own are not inclined to be colorfast and most fabrics on their own are not capable of absorbing dyes, especially in the case of man made fibres (Miller, 1968). Natural dyes, for example, almost always required a metal salt to be applied to the cloth before dying to increase the affinity of the dye for the cloth and, in some cases, to increase colorfastness or change the color of the dye (Landi, 1998).

Textile Decorations

After being manufactured, textiles can be decorated in a variety of ways including printing, painting, and embroidery. Printing is a decorative method used to apply color to one side of a textile. There are two classes of printing - the block method and the stencil method. The block method entails tracing a design onto a block of hard material and then either cutting away the portions that are not part of the design for relief printing or cutting away the portions that are part of the design for intaglio printing.

In stenciling a design is cut out of a piece of thin, hard, and non-absorbent material. This stencil is then used to paint or spray a design onto the cloth. Screen-printing is a variation of stencil printing in which a design is drawn on to a fine mesh screen. The parts of the screen that are not going to be printed are then blocked with a lacquer compound so that only the design is printed when ink is applied. In both block and stencil printing, a thick dye paste is required to prevent color migration during printing. After the dye is fixed by finishing processes, unwanted residues can be removed (Miller, 1968).

A common method of decorating larger items like flags and banners in the United States was to paint scenes and portraits on the surface of the textile as shown in figure 7. More elaborate banners may also have fibre-based decorations such as ribbons, tassels, and fringe like the banner in figure 8 (Collins, 1979).

When a banner or flag is painted, one of two painting substances may have been used. One type of paint employs thickening agents of animal or vegetable origin that are at least partly washed out after the paint dries. This type of painting leaves the structure of the textile visible and is usually employed on wool or linen. The other type of painting is similar to ordinary canvas painting. A paint paste with binding agents of animal or vegetable origin entirely covers the fabric and is sometimes covered with varnish as well. These types of flags are often painted on both sides because the paint does not penetrate the cloth.
Embroidery is another decorative method that also comes in two forms. In the first, images are sewn directly into the flag or banner cloth usually with silk or metal threads, but wool and linen yarns are not unheard of. In this type of embroidery, two pieces of cloth (a front and reverse) are always used and embroidered separately. One or two linings may also be used to strengthen the piece. In the other embroidery method, separately manufactured embroidered pieces are sewn onto the cloth. Attaching the embroidered pieces to a heavy inner lining is almost always necessary because thin cloth is not strong enough to support them (Lodewijks, 1972).

**Deterioration Mechanisms and Agents**

All fabrics and dyes and many other materials previously mentioned that are used in textile production are organic compounds that are subject to the same deterioration from external sources that other organic substances are subject to. Specifically, the polymer chains that form textile fibres are broken down, weakening the fibres on the microscopic level and eventually leading to brittleness of the entire textile.

While some breakdown is unavoidable, the rate of this process can be greatly slowed by controlling the agents in the textile environment that accelerate this process. Deterioration factors include finishing processes, light, humidity, heat, and exposure to acids and alkalis. Some of these factors work in combination to accelerate deterioration. For example humidity can cause mold growth that leads to acid production. All of these factors when alone or when combined with mechanical and physical stress can lead to irreversible damage (Landi, 1998).

**Finishing Processes**

The process of deterioration may begin before the textile even reaches the consumer. Certain dyeing processes and weighting are the two most damaging finishing processes (Finch and Putnam, 1985). As mentioned above, natural dyes often had to be used in conjunction with metal salts to make the textile accept the dye (Landi, 1998). In the case of very dark browns and blacks, iron was used as a mordant. Oxidation reactions involving the iron in the dye will eventually rot the fibres to such an extent that loss of the fibre is inevitable.

Weighting processes, most often used on silk, also have the potential to be extremely damaging. Weighting of silk was carried out extensively starting in 1870. In 1909 one company noted that “coloured silks could be weighted to between fifty and one hundred per cent and black silk up to four to five hundred per cent” (Finch and Putnam, 1985, p. 17). While this may have a desirable effect on the product for the consumer, weighting makes silk more susceptible to light and mechanical damage.

**Light**

Light can have a dramatic detrimental affect on all textiles as well as some dyes. Both visible light and UV light from sunlight and fluorescent tube lighting have the energy needed to activate chemical reactions that lead to deterioration, though humidity and oxygen are also needed (Landi, 1998). The deteriorating effect of light depends on the strength of the light and how long the item is exposed. It takes a surprisingly small amount of light to initiate deterioration. Experiments at the Doerner Institute in Munich demonstrated that fading of colored textiles can be observed after being exposed to an amount of light equivalent to 50 days of illumination at 500 lux for only 8 hours a day (Flury-Lemburg, 1988). 500 lux is about the amount of light present in a typical office or
home kitchen. Indirect sunlight averages 10,000 to 20,000 lux while direct sunlight averages 100,000 to 130,000 lux (Lux and Light, 2004).

**Humidity**

As well as participating in light activated reactions, high humidity causes fibres to swell and distort changing the shape of the textile object and causing some types of dyes to run or fade. Humid conditions also promote mold, fungus, and insect growth. Low humidity can also lead to damage by causing fibres to shrink and become brittle. Wool is especially susceptible to damage in dry conditions because its natural function is to absorb water. At the other extreme, in the same amount of humidity ideal for wool, silk will rot (Finch and Putnam, 1985).

**Heat**

Heat damage manifests itself in brittleness as well as a brown discoloration caused by the products of polymer breakdown. Heat can come from lighting mechanisms that are placed too close to the object as well as from heating systems. Storage in attics or storerooms without climate control can also lead to heat damage (Landi, 1998). Infrared light has also been known to have a detrimental warming effect (Flury-Lemburg, 1988).

**Acids and Alkalis**

In general protein polymers fibres will tolerate small amounts of acids while cellulose polymer fibres will tolerate small amounts of alkali, but it is best to limit exposure to both. There are several internal sources of acids and alkalis including dark brown or black dyes that have iron in them, and mold or insect waste (Landi, 1998). External sources include unsealed wood, non-archival paper goods, and urban pollution (Commoner, 1992). In sufficient amounts, both acids and alkalis will cause irreparable damage in any type of textile by provoking hydrolysis reactions that result in shorter, weaker polymer chains. Alkalis produce a particularly dramatic effect on wool, and a five-percent caustic soda, at the boil, will destroy wool fibres completely. Silks, because they are constructed of filaments, suffer the most from acid attacks that can break the filament polymer chains at any point (Landi, 1998).

**Preserving Textile Objects**

There are several techniques that can be used to avoid exposing textiles to the above deterioration agents. Many ways of repairing and cleaning textiles also exist; however, aside from careful vacuuming, these techniques are not recommended for those who are not trained in textile conservation. Many conservation methods have the potential to damage the textile further, and even professional conservators consider many factors before making the decisions on how to treat and repair a textile object. Wet cleaning is a widely used cleaning method, but it is extremely hazardous when done improperly. Loss of dyes or paints, the removal of water-soluble sizes, dimensional changes, and the production of a kind of “textile mud” when highly degraded textiles are exposed to water are among the possible results of wet cleaning (Landi, 38).

Another situation that requires caution and expert advice is when folded, aged textiles are discovered. If a textile object is found folded, it is best to contact a professional conservator for advice before attempting to unfold it. Even though the object may appear to be in stable condition, deep creases can cause damage over time.
causing the fabric to split when it is unfolded. Professional treatments such as humidifying may be necessary before the textile can be flattened (Haecker, 1995).

Non-professionals should focus on preservation methods that carry as little risk as possible for causing further damage. Fortunately, adequate preservation has become increasingly easy for the general public and entities with smaller budgets due to the availability of relatively affordable archival products over the Internet and elsewhere. A short list of companies with Internet sites that offer archival materials for sale is available in Appendix C. This list is provided only to aid in the search for materials and does not entail promotion of the establishments listed.

*Vacuuming*

In some cases, a textile may have surface dirt and dust that can be removed by vacuuming if the textile is not excessively brittle. The advice of a professional is recommended before this is performed to ensure that the textile is stable enough to endure this process. Dust removal is an important first step because layers of dust can carry aggressive corrosive substances such as sulphur dioxide, nitorgen monoxide, or various oily substances (Flury-Lemburg, 1988). Regular surface cleaning by vacuuming is necessary for any textile that is on display as well as for textiles with large amounts of surface soiling. A monofilament screening attached to an open frame should be placed screen side down on top of the area to be vacuumed to prevent fibre loss. The screen should be heavy enough to lie firmly on the textile during vacuuming, and the edges of the screen should be taped to prevent snagging of the textile. A photo of such a screen in use is shown in figure 1 in Appendix B. The hand held nozzle attachment of a vacuum with a low suction setting or a low powered hand vacuum can then be used directly on top of the screen to remove dust and surface dirt (Finch and Putnam, 1985). Any textile object that is at a point where small pieces are breaking off should not be vacuumed at all even under a screen because textile loss may occur.

It is also possible to surface clean a textile using a hand held nozzle or vacuum with the opening covered with fine net. This method is not usually recommended, however, because the vacuuming apparatus must be held slightly above the textile and cannot touch the textile directly without risking damage to the object. Much more caution is required for this method than for the screen method. Brushing is not recommended because it only moves dust around instead of removing it and has the potential to cause damage even when done lightly (Finch and Putnam, 1985).

*Storage*

The overall goal of any storage method should be to protect the object from the agents of deterioration mentioned above. The particular method chosen for storing any textile should be based on the textile’s condition and size, and all materials that come in direct contact with the object should be of archival quality. For example, sealed woods or metal, acid-free boards and tissues, unbleached muslin, and Mylar are all acceptable archival materials when used properly. Adhesives of any kind should never come in contact with the textiles. Light is usually the greatest threat to textiles and dyes and wherever the textile is stored it should be protected from both natural and artificial light sources. Ventilation is also necessary to avoid creating an atmosphere of concentrated corrosive substances that may originate from agents in the textiles or from environmental pollutants (Flury-Lemburg, 1988).
Relative humidity should be kept constant at a level between 50 and 60 percent to prevent fibres from expanding and shrinking repeatedly causing dimensional distortion (King, 1985). Silks should be stored at a slightly narrower range of relative humidity levels ranging from 50 to 55 percent (Scott, 1993). Rapid changes in temperature should be avoided because they usually cause changes in humidity and because high temperatures can cause heat damage and organism growth. Temperatures of 60 to 68 degrees Fahrenheit (15 to 19 degrees C.) are considered best for textiles. People are also a source of both heat and humidity, and storage areas that are not accessed frequently and not by more than a few people at a time are preferable (Commoner, 1992).

Excess handling and mechanical stresses are another source of damage. This damage can be minimized by limiting the amount of contact between items in storage by keeping detailed records of where each item is stored to reduce the amount of rummaging necessary and the number of items that must be moved when a particular object is requested. In some cases, it may be possible to provide high quality pictures to aid in this endeavor and to offer the user in order as a substituted for the item (Commoner, 1992). Whenever items are handled, they should be placed on a support such as a rigid piece of archival quality cardboard.

Items that have become detached from the textile such as fringe, tassels, ribbons, or original poles should ideally be stored with the original object; however, care should be taken to assure that any original hardware attached to the item will not cause further damage to the textile while it is in storage (Haecker, 1995).

Rolled Storage

Rolling and flat storage are the two best storage methods. Rolling is the most space efficient for large textiles that are in fairly good condition. It is important to note, however, that painted textiles should not be stored rolled because the painted areas will or are already stiffened by age. If these types of textiles are rolled, cracking, splitting, and paint loss can occur (Haecker, 1995).

Archival quality cardboard tubes are available in a variety of diameters and lengths for rolled storage. If archival quality tubes are unavailable other types may be used after first wrapping them in Mylar, buffered paper, and unbleached muslin in that order with the Mylar closest to the tube (Giuntini, 1992). Tubes with wider diameters should be used for thicker items. Textiles should always be gently rolled with the decorated side outwards because the side closest to the tube is prone to wrinkling if too much material is present. Acid free tissue paper is rolled between the layers and can also be used to wrap the outside of the rolled item (Finch and Putnam, 1985). Unbleached muslin cloth can also be used as a cover in cases where light exposure may be a problem. Wide fabric strips can be used to secure items that may come unrolled easily. These strips are best secured with Velcro, pins, or buckles instead of knots or tying (Landi, 1998).

After rolling, items should be stored in areas where they are protected from sunlight and dust but still well ventilated as previously noted. Tubes should never be stored in the vertical position, and the textile should never support its own weight (Finch and Putnam, 1985). The easiest storage method for smaller rolled textiles is inside a box with the tube ends supported. A variety of archival boxes are available for purchase from archival suppliers that could be used in this way. In cases where archival boxes cannot be purchased, other types of boxes or drawers (sealed metal or wood) lined with several
layers of acid free tissue paper or unbleached muslin can be used as a substitute. An illustration of the box and tube storage method is shown in figure 2. The method shown uses shaped Ethafoam for the tube supports. Non-archival types of foam should not be used because they could emit corrosive substances as they decompose. Sealed wood brackets could also be used but will add more weight to the storage system.

Larger rolled textiles can be stored on shelves in support brackets or horizontally mounted on a wall in brackets of sealed wood or metal. Dowels can be placed inside the tubes to provide extra support if needed. These types of systems can be protected from light by muslin covers over each object or by cabinets that cover several rolls.

**Flat Storage**

Small textiles (or even fairly large ones, space permitting) can be stored flat in properly lined and sealed metal or wooden drawers (Giuntini, 1992). This is also the best storage method for painted textiles (Haecker, 1995). Narrow drawers such as those in map cases or engineer drawing cases are the most space efficient for larger collections. Otherwise, boxes or other kinds of drawers can be used for storage. Heavy textile objects should not be stacked. Lighter objects of similar sizes may be stored in a few layers with acid free tissue paper in between items if no mounts are involved. Acid free tissue paper or unbleached fabric should also be used on top of the objects to prevent dust accumulation (Giuntini, 1992).

In some cases, there may be no other option but to fold a very large or heavy textile in order to store it. Sharp folds should never be used on historic textiles. Instead, rounded folds with crumpled acid free tissue paper inside the fold can be used. Acid free tissue paper should also be used between fabric layers. Folded textiles should be occasionally refolded in different areas to prevent weakening of any one area (Finch and Putnam, 1985).

**Mounting**

Items that are fragile, frequently handled, or destined for display might benefit from lining or mounting before being stored. Due to the fact that this involves sewing the object onto a fabric support, this should only be done with the professional assistance of a textile specialist. Improper mounting can cause significant damage over time due to mechanical stress and weakening of yarns in places where the stitches are made. Fairly detailed instructions are given here to aid in identifying any improper mounts that may be already be present. These should be professionally removed before they cause distortion or damage.

The material chosen for the support fabric should be identical or very similar to the textile material so that it will shrink or expand at the same rate as the piece being supported. The support fabric should also be pre-washed and shrunk before use. Threads may be silk, nylon, mercerized cotton, or a yarn pulled from the same kind of fabric being used for lining. Finer threads are usually preferable. Very thin curved needles are normally used for sewing and have less potential for damaging any yarns of the textile object while sewing.

The stitching can be done in two ways. One method is to sew one-half to three-fourth inch long stitches in rows starting at the center of piece and continuing through the entire piece. This allows for even weight distribution across several yarns for each stitch (King, 1985). The other method is to only sew only around the edge of the piece using
stitches that are perpendicular to the object. This method is illustrated in figure 3 of Appendix B and is usually used for small, fragile pieces that are being mounted to a fabric-covered paperboard or hard board. If this method is used, the board should be acid free and non-rubber based glue should be used to attach the cloth on the backside of the board only. Before the cloth is attached to the board, the corners can be mitered to assure a better fit. The cloth should be kept square to the board and attached before the object is sewn on to prevent the stitches from pulling holes in the textile object (Landi, 1998). In both mounting systems, the stitches should be loose enough so that the older textile is not strained, but tight enough so that the mounted textile will not move or abrade on the mounting (Landi, 1998 and King, 1985).

If a textile is so fragile that mounting with a needle and thread could potentially cause damage, the sandwich method of mounting may be used. In this method a backing material is stretched over a frame with the fragile textile placed on top. Then, crepeline-silk or polyester netting is placed over the textile and either sewn to the backing material or attached to the frame (King, 1985). Note that a textile should never be directly mounted in an open frame. Objects framed like this are subject to a great deal of mechanical stress. The will also age unevenly because the parts of the textile that are protected by the frame will not age as quickly as the parts that are open to the air (Landi, 1998).

**Display**

There are many perils involved in putting textiles on display including distortion from physical stress, exposure to deterioration agents, and vandalism. No historic textile should be on display for extended periods of time (Gross and Hauser, 1979). Display of textiles carries even more risk than mounting and, again, professional advice from a conservator or textile display specialist should be sought before making display decisions. Many textiles should not be displayed at all. The following descriptions of display methods are offered as a starting point for discussing options with a specialist. Additionally, as with mounting, it is advisable to be able to identify improper display techniques so those textile objects found in such situations can be immediately removed from danger.

As in storage, exposure to light is the chief concern when display is considered. Ideally, textiles should be displayed in an area where lighting can be removed or turned off when the objects are not being viewed, and textiles should never be displayed in an area where they will be exposed to sunlight of any kind. Fluorescent lights, because they emit UV light, should be fitted with UV filters or not used at all, and light sources should not be mounted close to the textile to prevent heat damage. In general, 50 lux is considered to be a safe amount of light for textile display (Gross and Hauser, 1979). While it is hard to determine the lux of light sources without the proper equipment, this is light that is slightly brighter than twilight (Lux and Light, 2004).

**Non-Hanging Displays**

Small mounted textiles can be easily displayed on their mounts in protective cases, preferably in a horizontal or angled position. If suitable cases for small textiles are not available and the items are in good condition, framing might be an option. The items should be mounted in the way described above in the “storage” section for a fabric covered paperboard mount. For framing, hardboard can be used in place of paperboard
as an extra barrier to humidity. When the piece is inserted into the frame, it will be necessary to insert very thin pieces of wood or an archival mat around the edges between the glass and the mounted textile object so that the glass will never come in contact with the textile. As usual, all the wood used in framing should be sealed to prevent damaging chemicals from seeping into the textile. Taping the glass into the frame with framing tape or other tape of archival quality, and taping any gaps that are present after the backing is put into the frame will prevent dust from reaching the textile while it is framed (Finch and Putnam, 1985).

If the items will only be on display for a short period of time and are not already mounted, pin couching may be ideal. In pin couching, a block of foam is used as a base for directly pinning a textile with stainless steel needles. The foam should be of archival quality to prevent hazardous gases from contaminating the object and it should be covered in pre-washed and shrunk fabric before use. The pins can be pushed almost entirely into the foam and should be inserted carefully through the weave of the textile object to prevent damaging any yarns. The positions of the pins should be varied across the textile so that the same warps and wefts do not come in contact with the pins multiple times. Spacing of 1 to 2 and one-half inches is ideal (Brown, 1989).

Hanging Displays

Larger textiles that are difficult to display horizontally can be vertically mounted, but this type of mounting is the most hazardous of all techniques and should be approached with caution and with advice from a professional conservator. Woven materials are the best candidates for vertical hanging because they are the most resistant to distortion. Almost all textiles that will be hung should first be lined using the all-over stitching method described above. Only very heavy textiles can be hung unlined (King, 1985).

It is especially important to consider carefully what kind of lining will be used when textile objects are displayed. When large textiles like flags and banners were displayed in the past, coarse cotton netting was often sewn directly onto the object before being displayed. While this method of display did provide some support and allowed the objects to be easily viewed from both sides, it also caused a great deal of damage through abrasion. Silks especially suffered and large holes formed where the netting was knotted and where silk threads had held the netting in place. The items may have also been hung in places where draughts would put them in motion causing further abrasion on the net or other backing material.

Other items were sewn onto inappropriate backings that caused distortions over time (Flury-Lemburg, 1988). This is exactly what happened when the famous Star-Spangled Banner was treated in 1914. A heavy linen backing was added that tripled the weight of the 30 by 34-foot garrison flag to 150 pounds, stretching it into a rectangular shape that it had previously lost. The lining has since been removed and a highly publicized conservation effort has begun to repair the damage caused by the lining as well as other damaged areas (Olson, 2003). These previous conservation and display effort demonstrate the importance of choosing an appropriate lining material as described in the above “storage” section.

After the lining is attached a hanging system can be implemented. The two most common hanging systems are sleeve and Velcro systems. A sleeve system involves sewing a horizontal sleeve onto the back of the top edge of the textile so that a wooden or
metal pole can be inserted. The pole is then hung on brackets mounted in the wall. As in all other cases wooden rods should be sealed while metal rods should be rustproof. Additionally care should be taken so that sewing does not damage the textile when the sleeve is attached. Some display specialists prefer rectangular rods instead of round rods because the latter tend to tip the item forward when hanging. In either case the sleeve should be sewn on slightly below the top edge of the textile and extend the entire length of the textile minus one centimeter on either side. An illustration of a sleeve designed for a rectangular mounting pole is provided in Appendix B, figure 4 (Landi, 1998).

The Velcro system is easy way to display large or medium sized textiles, and it also allows for items to be moved quickly and safely. To implement a Velcro system, cut strips of Velcro (one hooked and one looped strip) that are 2 centimeters shorter than the textile being hung. Create a sleeve from folded cotton fabric and machine-sew the looped Velcro strip onto the cotton on all four edges. This is shown in figure 5 of Appendix B. The mounted Velcro strip can then be hand sewn onto the textile just below the top edge of the fabric. Both the lining and the textile itself should be carefully incorporated into the stitches. The hooked strip of Velcro is then mounted onto a strip of sealed wood that is then mounted to the display wall. The textile can then be pressed onto the wooden mount beginning from the center and moving outwards. An illustration of the finished mounting system is shown in figure 6 of Appendix B.

Hanging methods using rings or tabs should be avoided because they do not provide an even distribution of weight across the length of the textile and will distort the weave of the textile (Velcro Support System for Textiles, 1996). Clamp systems can also provide the necessary support but their construction is relatively complicated and they do not provide any significant benefit over simpler systems.

Finally, the hanging textile should be protected from handling and vandalism while on display. This can be particularly challenging for large items because museum quality cases are expensive and the textile needs to be ventilated and protected at the same time. A simple and inexpensive way to achieve this is to mount Plexiglas sheeting over the hung textile with spacers inserted between the sheet and the wall to prevent the textile from coming into contact with the Plexiglas. A photograph of this type of display is shown in figure 7 of Appendix B. The finished system should prevent the textile from touching both the Plexiglas and the wall to prevent the transference of any harmful chemicals and to increase air circulation (Gross and Hauser, 1979).

**Conclusion**

Even with limited experience or a small budget, utilizing basic knowledge about textile structure and deterioration can effectively preserve flat textile objects. Almost all components of textile objects are organic compounds and will inevitably decompose over time, but how quickly a particular object decomposes can be controlled to some extent through proper care and handling. The underlying idea in all the systems described above is that storage systems should always be designed with the agents of deterioration in mind. Systems that protect from pollution, excessive handling, dust, heat, humidity, and especially light can slow the inevitable deterioration of textiles considerably and preserve them until professional textile conservation can be performed. Textile objects that are in relatively stable condition might also be safely displayed for short periods of time by following the same basic guidelines outlined for storage systems, although it is
recommended that professional advice be sought before implementing a display system. When full professional conservation is not a possibility, preservation can ensure that little further damage is done and that the textile can be safely viewed and enjoyed.
Appendix A
Textile Structures and Decorations
Figure 1- Diagram of plain weave  
(Miller, 1969, p.12)

Figure 2- Diagram of weft knitting  
(Miller, 1969, p. 14)

Figure 3- Diagram of a simple net  
(Miller, 1969, p. 15)

Figure 4- Net banner advertisement from the Reuben Wood’s Sons 1892 catalog.  
(Collins, 1979, p. 22)

Figure 5- Diagram of a braid  
(Miller, 1969, p. 16)

Figure 6- A cotton bandanna from year 1840 with a Turkey red background and portraits of Handcock and English.  
(Collins, 1979, pp. 39 and 223)

Figure 7- A painted banner on cotton canvas from the year 1840.  
It depicts General William Henry Harrison on horseback. Painted by Alfred Pease of Oberlin, Ohio.  
(Collins, 1979, pp. 32 and 89)

Figure 8- Elaborately decorated parade banner of velvet and silk with metallic embroidered text.  
(Collins, 1979, pp. 41 and 246)
Appendix B
Textile Preservation
Figure 1- Photograph of vacuuming a textile with a hand attachment through a monofilament screen. (Finch and Putnam, 1985, p. 59)

Figure 2- Storage system for rolled textiles in a box or drawer using Ethafoam supports. (Giuntini, 1992, p. 76)

Figure 3- Diagrams showing how to apply fabric to a mounting board and how to sew around the edges of a textile using a curved needle. The stitches should be perpendicular to the textile. (Landi, 1998, p. 163)

Figure 4- A diagram of a sleeve designed for a rectangular pole (batten).
The sleeve is sewn on the back of the lined item slightly below the top edge.  
(Landi, 1998, p. 167)

Figure 5- Diagram of a loop strip of Velcro being attached to a cotton support.  
(Velcro Support System for Textiles, 1996, p. 1)

Figure 6- Diagram of a complete Velcro mounting system.  
(Velcro Support System for Textiles, 1996, p. 2)

Figure 7- Photograph of a hanging textile behind a Plexiglas shield.  The Plexiglas is held away from the textile using wooden spacers.  (Gross and Hauser, 1979, p. 64)
Appendix C
Suppliers
Archival Methods
235 Middle Road
Henrietta, NY 14467
(866) 877-7050
http://www.archivalmethods.com
mail@archivalmethods.com

Gaylord Bros.
PO Box 4901
Syracuse, NY 13221-4901
800-634-6307
http://www.gaylordmart.com
customerservice@gaylord.com

Genealogical Storage Products
(The Hollinger Corporation)
9401 Northeast Drive
Fredericksburg, VA 22408
800-634-0491
http://www.genealogicalstorageproducts.com
GenealogyStore@aol.com

Masterpak
145 East 57th Street- 5th Floor
New York, New York 10022
800-922-5522
http://www.masterpak-usa.com
service@masterpak-usa.com

Metal Edge, Inc.
6340 Bandini Ave
Commerce, Ca 90040
800-862-2228
http://www.metaledgeinc.com

Talas
20 West 20th Street
5th Floor
New York, NY 10011
212-219-0770
http://www.talasonline.com
info@talasonline.com
University Products
800-336-4847
http://www.universityproducts.com
custserv@universityproducts.com
Sources


CCI Notes 13/4: Velco support system for textiles. (1996). Ottawa, ON: Canadian Conservation Institute


