

Conservation Book Repair: A Training Manual

by
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Alaska State Library, Alaska Department of Education, 1995

II. THE BASIC INFORMATION

Understanding book construction, the materials used to repair books and the proper way to handle tools are important components of a successful repair program.

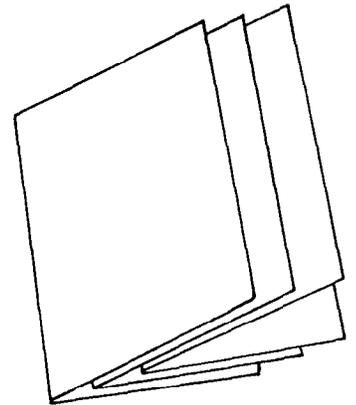
Books are constructed in several ways. Many repair materials work best on certain kinds of paper or in specific parts of a book. "The right tool for the right job" is an axiom that applies to book binding as well as other fields. Having a few specialized tools and understanding how to use them will save time and energy.

A. BOOK STRUCTURE AND CONSTRUCTION

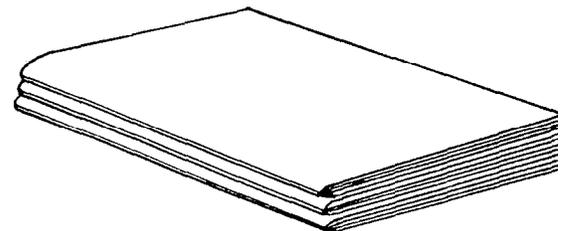
The pages of a book, whether they are sewn or glued together, are called the text block. The covers of a book are called the case. The case is made of the front cover, the spine and the back cover.

1. TEXT BLOCKS IN SIGNATURES

When the text block is sewn, the pages are gathered together in groups; then each group is folded in half.



A group of folded pages is called a section or signature and is usually four to eight pieces of paper (four pieces of folded paper equals sixteen numbered pages).



Books that are constructed of sewn signatures tend to function best because the pages are securely attached to one another and they open flat.

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Modern manufacturing techniques enable book manufacturers to create a text block with signatures, cut small notches in the folded edge and insert glue to hold the pages together instead of sewing thread. These books look like they are sewn, but they are not. Open the text block to the center of a signature and look for the thread, if it's not there, the book is glued.

2. TEXT BLOCKS IN LOOSE SHEETS

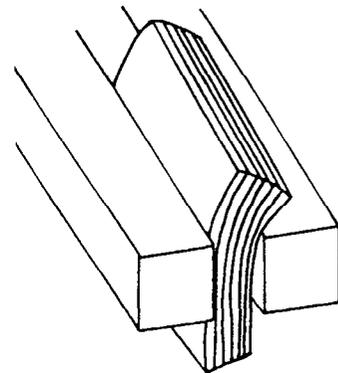
Text blocks can also be single sheets glued together in a process called adhesive, perfect, or fan binding. In this process, fast drying glue is applied to the spine of the text block.

Adhesives that dry very quickly are often brittle and that is why the spine of a book cracks when the book is opened. Once the spine glue is cracked, the pages will begin to fall out.

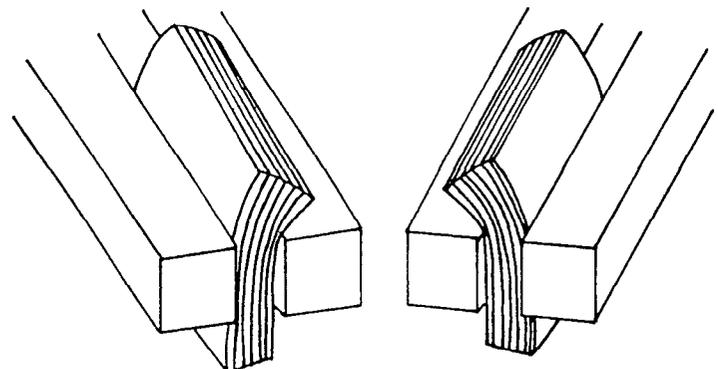
In addition to the problem of brittle glue, there is often very little glue attaching each page to the adjoining pages. When the glue is only in contact with the very thin edge of each sheet of paper, pages can easily separate over time.

3. SINGLE AND DOUBLE FAN BINDING

In single-fan binding, the pages of the text block are fanned in one direction and glued along that fanned edge. In this style of binding, a thin line of glue penetrates the inner margin of each page, not just the spine edge.



Double-fan adhesive binding goes another step beyond single-fan binding. After the pages are fanned in one direction and glued, they are also fanned in the opposite direction and glued along the second fanned edge. Double-fan binding applies glue on



the inner margin of each side of the page, not just on the spine edge or the inner margin of one side of the paper. It is much stronger than single-fan binding.

When library binders bind a book using double fan binding, they use adhesives that dry slowly and flexible. In addition, they usually reinforce the spine edge of the adhesive bound text block with cloth and paper so it is stronger and the text block opens flat.

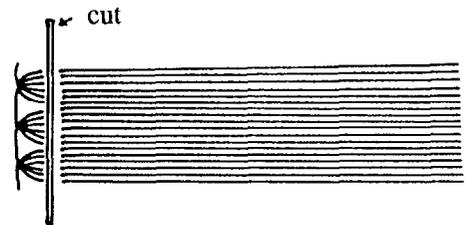
A library binder can be a good source of information to understand the binding processes. Keep in mind the bindery is selling a product and as the customer, you can question the binder until all the techniques are fully explained. The services offered must meet the specifications that a library has defined for its collections.

In order to set minimum levels of excellence in library binding, the Library Binding Institute has published the *Standard for Library Binding*. This booklet explains the different types of bindings and what standards should be met in library bound books. The *Guide to the Library Binding Institute Standard For Library Binding* written by Jan Merril-Oldham is a plain English explanation of the Standard.

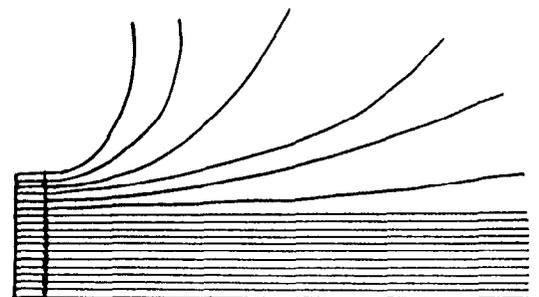
4. OVERSEWN TEXT BLOCKS

Before library binderies began to fan bind books, the most common form of library binding was oversewing.

In the oversewing process, the folds of the signatures are trimmed off and the pages of the text block are oversewn to one another with a diagonal whip stitch.



Since the sewing threads tend to pierce deep into the inner margin, the pages are restricted from turning easily.



Oversewing is a strong form of binding, but it is often so strong that over time the pages can break out of the binding as they are forced to turn against the sewing threads. Oversewn books may not be candidates for rebinding since much of the inner margin was trimmed off or damaged by the oversewing threads.

Books should not be oversewn unless they are very heavy and have wide gutter margins to accommodate the sewing threads. Many libraries stipulate their binders must have permission to oversew a volume.

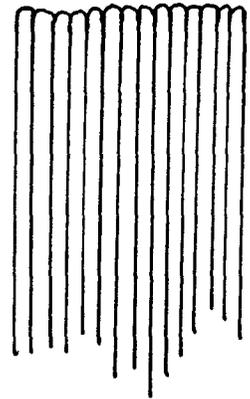
5. SEWN TEXT BLOCKS: Flat Back and Rounded and Backed Text Blocks

The pages of a book attached together by sewing or gluing is called a text block. Before a text block is attached to a paper or book board case, it can be treated in several ways.

Flat Back Text Blocks

Flat back books are a type of binding which has a flat text block spine. The case spine of flat back books is usually a piece of book board covered with book cloth.

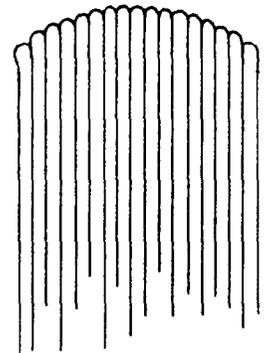
The spines of flat back text blocks have a tendency to become concave over time. To prevent this, the spine of the text block can be rounded and backed.



Rounded and Backed Text Blocks

Text blocks are rounded and backed to shape the flat spine of a text block into a curved spine with shoulders.

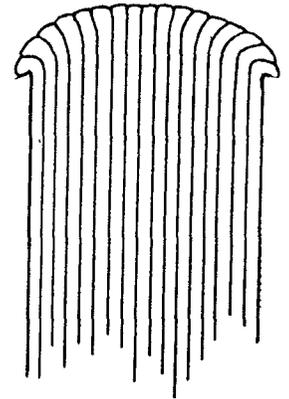
Rounding a text block is the process of molding the spine of a text block into an arc of approximately one-third of a circle. Rounding takes place after the pages of the text block are attached to one another by sewing or gluing. A light coat of adhesive is applied to the spine which is then worked into shape with light



pressure, applied with your fingers or a special hammer called a backing hammer.

Backing is the process of shaping a ridge or shoulder on each side of the spine of a text block prior to attaching the spine lining material.

Using a backing hammer, the folds of each signature or glued pages are bent over from the center to the left and right until shoulders are formed against which the boards will fit. The width of the shoulders is determined by the thickness of the cover boards.



In addition to providing space for the cover boards, backing also distributes the swell caused by the sewing threads or adhesive and helps maintain the round of the text block over time.

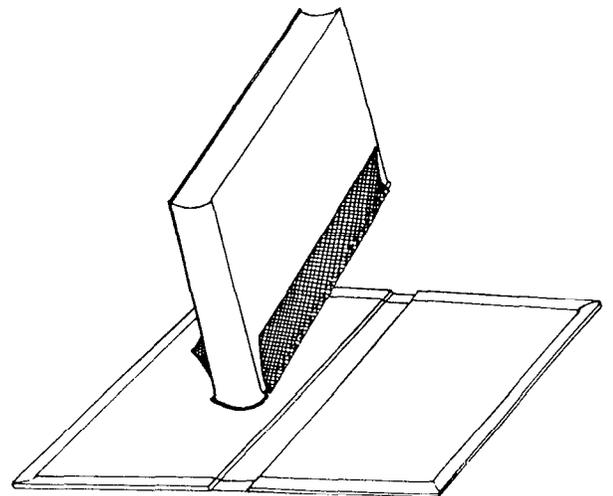
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6. BOOK CASE CONSTRUCTION

Regardless of how the text block is assembled, modern books are usually manufactured in two stages.

The text block is constructed in one operation where the pages are attached to one another, the spine covered with a cloth liner, called crash, and a paper spine liner is added over that.

The book case, consisting of a front cover, a spine and a back cover, is constructed separately in a second operation and the two parts of the book are attached by gluing the crash and end papers to the case covers. The crash holds the text block into the case while the end papers cover up the crash.



B. PAPER AND BOOK CLOTH

Many types of paper or book cloth can be used in manufacturing, binding and repairing a book.

1. PAPER

Although many different types of papers are used to print and manufacture books, three important types of paper to be familiar with in book repair are uncoated paper, coated paper and acid-free paper.

Uncoated Paper

Uncoated paper is the most common type of paper and is made from plant or tree fibers that are processed into sheets. Originally, most uncoated paper was handmade from linen or cotton rags. These older papers age very well because they contain few damaging chemicals.

In the 1860s, a process was developed to turn cellulose fiber from trees into paper. This type of paper can be made in large quantities but contains some very damaging chemicals that cause paper to become brittle more quickly than paper made from cotton or linen.

Coated Paper

A sheet of paper can be impregnated with very fine clay to produce a very fine printing surface. Introduced at the end of the 19th century, coated papers is ideal for printing halftone illustrations. Unfortunately it is not very strong and is highly susceptible to water damage.

Often the text pages of a book are printed on uncoated paper while the pages that contain illustrations are printed on coated paper. The coated paper may be part of the signature or tipped onto a page uncoated page.

Acid-free Paper

Acid-free is a designation given to paper that has a pH value of 7.0 or greater on a scale of 1 to 14. Fibers from any source can be made into paper that is acid-free. Both coated and uncoated papers can be acid-free.

Acid-free paper used in conservation book repair includes photocopy paper and Japanese repair tissue.

2. BOOK CLOTH

Book cloth is a specially woven cloth backed with thin paper. The paper backing gives the cloth support, minimizes stretching and allows the material to maintain a crease.

There are three main categories of book cloth.

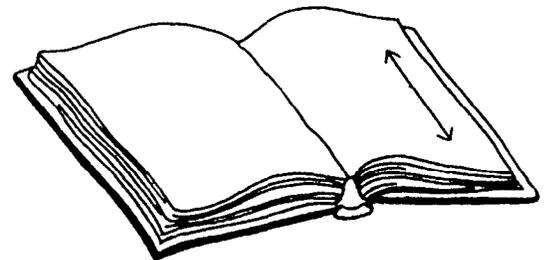
- Starch-filled book cloth in which the weave of the cloth is filled with starch. This type of cloth is sometimes called sized book cloth.
- Acrylic-, polyoxylin-, or vinyl-impregnated book cloth.
- Plastic coated book cloth

Heavier book cloth is sometimes called buckram.

3. PAPER AND BOOK CLOTH GRAIN

Paper and book cloth have a grain just as fabric does and it is important to understand how that grain affects repairs.

When the grain of the paper and book cloth runs parallel to the spine of the book, the cover and pages open freely and stay open without much effort. This is called "with the grain".



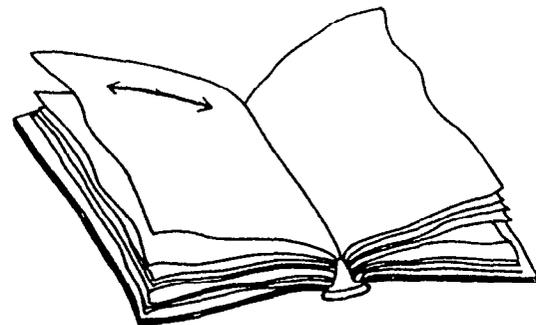
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Paper that is bound into a book with the grain running perpendicular to the spine of the book is called "against the grain".

Modern publishers often print the pages of a book against the grain to get more pages on a large sheet of paper.

When the grain runs perpendicular to the spine of a book, the book can be difficult to open and it will not remain open without a great deal of pressure.



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Books printed against the grain are easily damaged since patrons must force the book open to read or photocopy it.

When pages or the case of a book are repaired, the grain of the repair materials should always run parallel to the spine of the book.

Determining the Grain of Paper or Book Cloth

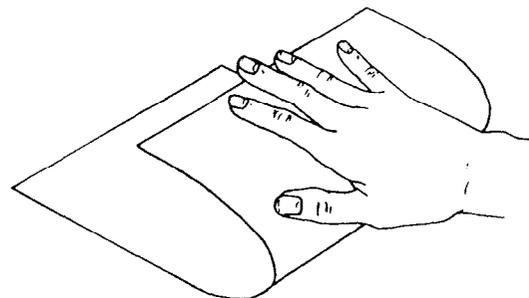
All paper and book cloth has a dominate grain. Paper can be tested for grain using the bend test, the tear test or the water test.

The grain of book cloth usually runs parallel to the selvage or bound edge of the fabric. If the selvage of the book cloth has been cut off or if there is any doubt about the grain of book cloth, the bend test or the tear test can be used to determine the grain.

Bend Test

The quickest way to test the grain is to bend the paper or cloth slightly in each direction.

Bring two opposite edges of a piece of paper or cloth together but do not crease. Instead, gently press down on the bend with minimal pressure. Feel any resistance.



Now bring the other two opposite sides of the paper or cloth together and repeat the process.

In one direction there is more resistance than the other. The greater resistance means the paper or cloth does not want to bend in that direction because it is bending against the grain.

When the paper or cloth is bent in the opposite direction, there is much less resistance. The bend that offers the least resistance is the bend that goes with the grain of the paper or book cloth.

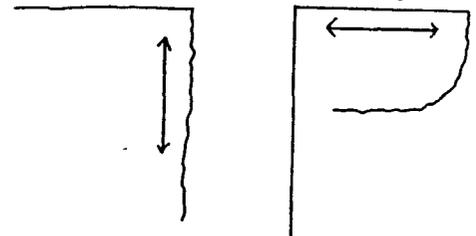
Mark the direction of grain on the paper for future reference.

Tear Test

Another way to test for the grain is to tear the paper or cloth.

Paper or cloth will tear easily and straight along the direction of the grain.

When forced to tear against the grain, the paper or cloth will be difficult to tear and the tear will tend to curve until it meets the grain.

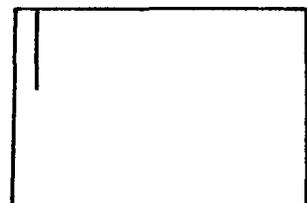


Tear the cloth or paper close to a corner and then pencil a small straight line in that corner indicating the direction of the grain so it won't need to be determined every time it is used.

Water Test

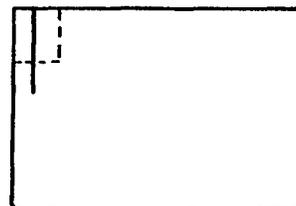
When grain is particularly difficult to find, a water test can be used. Use this test only to test paper being used to repair a volume, **not** on pages bound in a book.

Draw a 4" straight line along one corner of a large sheet of paper. This line will not necessarily be the grain line, it is simply an orientation line.

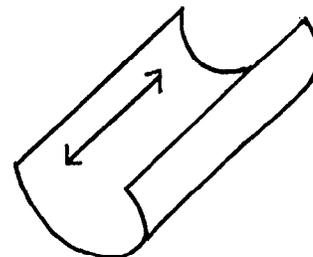


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Cut a square out of the corner, including 1/2 of the line.



Moisten the small square of paper and lay it on a work surface. As the water is absorbed into the paper fibers, the square will begin to curl. The two edges that curl toward one another are parallel with the grain. Mark the correct grain on the square.



Replace the curled square in position on the large sheet of paper (match the cut pencil line) and mark the correct grain on the large sheet. Remember, the first pencil line is not necessarily the grain line.

C. PAPER REPAIR MATERIALS

Conservation book repair generally uses Japanese repair tissue, wheat paste, and heat-set tissue or archival repair tape to repair paper tears.

1. JAPANESE REPAIR TISSUE

Japanese repair tissue is sometimes called "rice" paper, but this thin paper is made from the fibers of the mulberry tree, not from rice as the nickname implies. The strength of Japanese repair tissue comes from its long fibers which make the paper very strong, even though it is very thin.

Handmade Japanese repair tissues are made on a mold and have mold or "chain" lines which can be seen in the paper. These lines generally run the same direction as the paper grain. The lines are visible when the paper held up to a light or held down to let the light shine from above. The grain can also be determined by using the tear, bend or water test discussed previously.

In general, Japanese repair tissue is torn rather than cut. A piece of torn Japanese tissue has a delicate feathered edge that blends into the repaired paper, so there is no sharp edge for the repaired page to turn against. Different methods of tearing Japanese tissue are discussed later in the **BOOK REPAIR TOOLS AND TECHNIQUES** section.

Japanese repair tissue can be purchased in different weights and colors. Generally, three weights will cover most repair needs. Since most paper is not truly white, buy the "natural" or "toned" colors.

- **TENGUJO** light weight for working over type or illustrations
- **KIZUKISHI** medium weight for most repairs
- **SEKISHU** heavy weight for heavier paper

Although Japanese repair tissue may seem very expensive, only a small amount is used on any one tear. One sheet of Japanese repair tissue will last a long time.

2. HEAT-SET TISSUE

Heat-set tissue is a thin tissue that has been coated with a heat activated, acrylic adhesive. The tissue is torn or cut to fit the tear or paper loss, laid in position and covered with silicone release paper (so the tissue doesn't stick to the hot iron). The tissue is adhered to the paper with a heated iron (approximately 100 degrees F.).

A standard household iron or tacking iron from a book repair supply house or hobby store can be used to adhere heat-set tissue. Heat-set tissue is sold with the silicone release paper.

Heat-set tissue tends to be more brittle than Japanese repair tissue as it does not have the long, strong fibers of the Japanese tissue. It is not recommended for use on the folds in paper or areas that need to flex and bend. Since heat-set tissue is not applied with moisture, it works quite well on shiny, coated paper that can buckle when wet.

3. DOCUMENT REPAIR TAPE

Document repair tapes differ from common clear plastic in several ways.

The carrier (the part of the tape that holds the adhesive) is thin, acid-free paper, not plastic. It is not as stiff as plastic tape so a page can turn and bend more easily. The adhesive used is a neutral acrylic adhesive that should not dry up, yellow over time or seep out the edges of the document repair tape. Because this adhesive is neutral (neither acidic nor alkaline), it should not react chemically with the paper.

The manufacturers of these tapes have tested the materials using artificial aging tests and they believe these tapes will remain stable over time and can be removed easily. Actual experience is not always so positive. Some libraries are finding that these tapes dry hard and crack or that the adhesive dries up and the paper carrier falls off leaving the paper discolored. In addition, some tapes are not reversible over time.

Because of these problems, document repair tapes should not be used on valuable books or books that are a part of a long-term permanent collection.

Document repair tape has become accepted for use in some circulating collections and is definitely better than clear plastic tape. Some libraries choose to use document repair tape on materials that will not remain in the collection for a long time, such as reference books or children's books. Document repair tape can be a quick way to repair paper tears, and staff can use it easily after very little training.

Document tape is sold under several brand names. Some of these are Filmoplast P, Filmoplast P-90, and Document Repair Tape

4. CLEAR PLASTIC TAPE

Many library books are repaired with clear plastic tape. What appears to be a quick solution can become a long term headache in a library repair program. Before using plastic tape, it is important to understand how it works and how it affects books.

Plastic tape is dangerous to use in books because it is unstable and causes a great deal of damage. Often two or three layers of tape will cover a single repair. The first repair did not work and additional layers of tape were added to correct the problem. Unfortunately, adding more layers of tape only creates a thick pile of tape; it does not repair the book.

Plastic tape has two main parts: a clear plastic carrier and an adhesive that sticks to the paper. As the tape ages on a piece of paper, the adhesive penetrates the paper fibers of the page and causes a chemical reaction that stains the paper and makes it brittle. Once the adhesive has dried, the plastic carrier falls away and the stain remains. The adhesive on the tape seeps out the edge of the plastic carrier, attracting dirt or adhering one page to another.

Once tape is in a book it is very difficult, if not impossible to remove. Simply lifting the tape off the page will damage the paper because the top layer of paper is removed with the tape. If the tape covers the text, it cannot be removed without damaging the print. Removing plastic tape is difficult even for trained conservators who work with chemicals and special tools.

Using tape to reattach a loose page restricts the page from turning freely. The tape has a sharp edge and makes the original paper heavier than before so the paper tends to turn against the edge of the tape and not at the hinge. Soon the paper breaks against the edge of the tape and falls out of the book. Now a second repair is needed and if the page is repaired a second time with plastic tape, the same problem occurs.

Wide, clear plastic tape is also used to repair the cover spine or corners of a book and special "repair wings" are sold to repair corners as well. While tape covers up the problem but it does not repair it. Often the tape slides out of position or detaches entirely while the adhesive remains on the book cover attracting dirt or sticking books to one another on the shelf.

Some libraries that practice conservation book repair may use plastic tape in very specific instances. Plastic tape might be used when a book will not remain in the collection for a long time, such as children's books, reference books that are updated regularly, or books that need "one more circulation" before they are discarded.

Decisions regarding when and how to use clear plastic tape should be made ahead of time. Be certain a book is not important in a long term collection

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policy before repairing it with plastic tape. Keep in mind that once the tape is in the book, it cannot usually be removed without damaging the book.

D. REPAIR ADHESIVES

There are two main kinds of adhesives used in conservation book repair: paste and glue. Each has special properties and should be used in specific instances.

1. PASTE

Paste is generally a cooked mixture of water and vegetable starch, such as wheat or rice. Repairing paper with paste will give a stronger bond than repairing it with glue because the paste soaks into the paper fibers and bonds them together. Since paste contains water, it can stretch and cockle paper. It dries slowly and can usually be reversed with water.

Wheat Paste

Wheat paste is used to mend torn paper, attach Japanese tissue or soften old paste and glue. It is not usually used on book cloth or the case of a book. Wheat paste can be purchased uncooked, instant or pre-made. Wheat paste prepared from scratch will last for 3 - 4 days before it begins to mold. Prepare a small amount of paste and keep it refrigerated.

Instant commercial or prepared pastes can be convenient in some situations. These pastes are available from several sources listed in the SUPPLY SOURCES, page 118.

Thick Wheat Paste (general pasting)

6 TBS wheat starch
2 Cups cold water

Place the wheat starch in the top of a double boiler.
Mix the water into the starch stirring constantly.

Bring the mixture to a boil.
Lower the heat and stir constantly as the mixture simmers.
Cook until mixture thickens.
Remove from heat and cool.
Put through a sieve and store refrigerated for 3 - 4 days.

Thin Wheat Paste (used to thin PVA)

3 1/2 TBS wheat starch
2 Cups cold water

Follow the instructions for Thick Wheat Paste above.

Microwave Wheat Paste

one tablespoon wheat starch
five tablespoons distilled water

Place the wheat starch in a deep container, add distilled water and place in microwave. Microwave on high setting 20 - 30 seconds, remove paste and stir. Return to microwave and cook another 20 - 30 seconds. Remove and stir again. Continue this process for 3 - 4 minutes depending on the power of your microwave. Paste should stand a few minutes before using.

2. GLUE

Several types of glue have been used in bookbinding over the years, the most common being animal hide glue. In recent years, animal-based glues have been replaced with synthetic vinyl resin glues, the most common of which is polyvinyl acetate emulsion (PVA).

Polyvinyl Acetate (PVA)

PVA is a good all-around adhesive. It has a low moisture content and dries quickly. It dries flexible, so it can be used to tighten hinges, repair book cover corners and reattach loose book cloth to book board. PVA is not

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affected by mold or fungi. However, it is damaged by freezing, so most book repair supply houses will not sell PVA by mail from October to March. If PVA freezes, it separates and loses its adhesive properties.

PVA can be thinned with water or thin wheat paste for different consistencies and effects. Thinning PVA with water adds moisture and does not add any additional adhesive properties while thinning with wheat paste adds the adhesive qualities of the paste to the glue. Many book binders or repair technicians use a 50/50 mixture of PVA and wheat paste strained through a sieve. Other books may describe different adhesives or mixtures of adhesives.

PVA glues cover a wide range of brand names and not all are used to repair books. For instance Elmer's glue is technically a PVA but is not flexible when dry so it has limited use for repairing books. Two common brand names for PVA glues used in book repair are AT-1100 from Colophon Book Arts Supply and Jade 403 available from Talas. These companies are listed in the SUPPLY SOURCES.

3. WORKING WITH ADHESIVES

Most people learning to repair books use too much adhesive. The belief seems to be that if a little is good, a lot is better. In book repair, that just isn't true. A thin, even coat of adhesive makes the best bond. Too much adhesive will ooze out of the edges of a repair and bond to the pages. Also, too much adhesive causes the paper to wrinkle and takes longer to dry. Watch each repair carefully. If there is excess glue or paste, wipe it away. Next time, try to use less paste or glue.

When applying adhesive, choose a brush that matches the size of the surface. When pasting or gluing a small area, use a small brush. When the area is larger, use a bigger brush.

E. LINEN THREAD

Books are traditionally sewn with linen thread which is very strong and can be purchased in several sizes. Choosing the right thread is important for a successful repair. Using thread that is too thick can damage a book because the text block may not fit back in the original case. Thread that is too thin can tear through the folded signature paper. In general, it's best to use as

thin a thread as possible, but choosing the right thread depends on the kind of paper and how many signatures are being re sewn.

1. THREAD SIZES

Common sizes of linen thread are 12/4, 18/3, 25/3, 35/3 and 60/3. The first number is the thickness of the strand or ply and the second number is the number of strands or ply per thread. So 12/4 is composed of 4 strands that are 12 thick. The 12 refers to an industry designation that relates to the weight of the wholesale quantities of thread. In this sizing system, the smaller the number, the thicker the thread so 12 thread is thicker than 60 thread.

35/3, 30/5, and 18/3 are a good assortment of thread to have on hand. It can be hard to recognize a particular thread size so it's a good idea to mark the size of thread on the inner cardboard spool before discarding the paper wrapper.

2. WAXING AND THREADING LINEN THREAD

Like all thread, linen thread has a tendency to tangle. Waxing sewing thread with beeswax keeps the thread from tangling and helps the thread "grip" the paper. Run the thread through a cake of beeswax two or three times to coat it with wax, then run the thread through your fingers. The heat generated from the friction will melt the wax into the thread.

3. MEASURING THREAD LENGTH

The length of thread needed depends on the height of the book and how many signatures need to be re sewn. Save time by measuring the thread directly on the book.

For instance, a book with one unattached signature will need a piece of thread that is at least three text block heights long plus one text block height for tying knots.

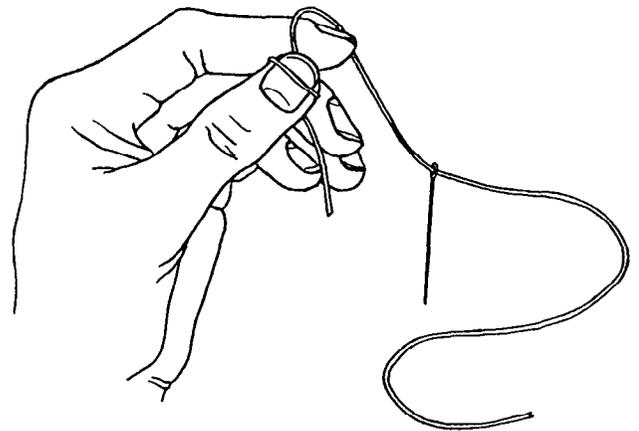
4. ADDING ADDITIONAL LENGTHS OF THREAD

It's not a good idea to try to work with more than 4 - 5 book heights of thread at one time. There are two ways to add additional lengths of thread discussed in **TYING KNOTS IN THREAD**, which follows.

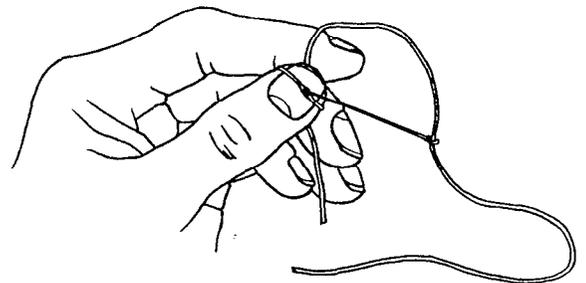
5. LOCKING THE THREAD ONTO THE NEEDLE

It can be very frustrating to have a needle fall off the sewing thread in the middle of a repair. Lock the needle onto the thread before beginning a repair to assure the needle will not fall off during the repair.

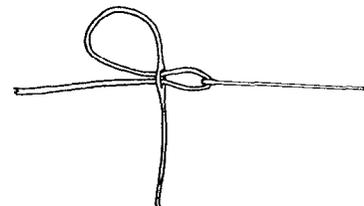
Thread the needle as usual.



Grasp the leading end of thread (the end that was threaded through the eye of the needle) and wrap it around your thumb.



Carefully pierce the thread with the needle against your thumbnail.



Pull the needle through the pierced thread.

Hold onto the sewing thread and pull until the pierced thread is tight against the sewing needle.

6. TYING KNOTS IN THREAD

There are two basic knots used in book repair, the weaver's knot and the square knot.

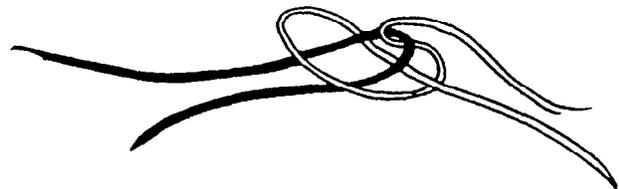
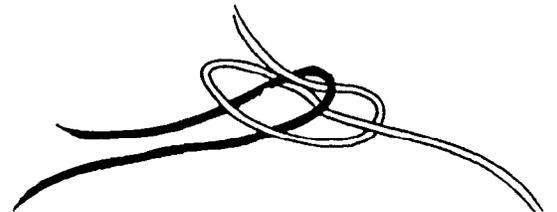
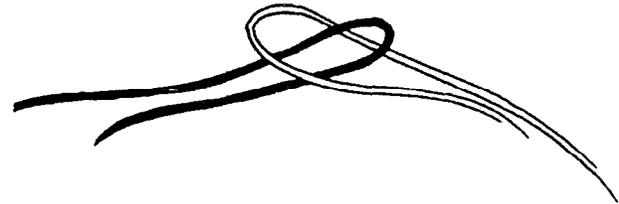
The Weaver's Knot

Since sewing with a very long piece of linen thread can be difficult, the weaver's knot is used to tie on additional lengths of thread so shorter lengths can be used.

Tie on additional thread when there is about 6" of thread left on the needle.

Tie the knot inside the signature, as close to the last sewing station as possible. A knot cannot easily pass through a sewing station hole so it should lie between the sewing station holes on the inside of the signature.

1. Make a loop of the remaining thread and hold it in your left hand, with the short end of the loop on the bottom.
2. With a new thread, make a loop with the short end on the bottom and hold it in your right hand.
3. Insert the left-hand loop underneath and *into* the right-hand loop and hold both in place with your left thumb.
4. Take the short end of the right-hand loop under and through the left-hand loop as illustrated.
5. Pull the short end of the left-hand loop and both ends of the right-hand loop away from each other until the knot is secure. Trim both ends.

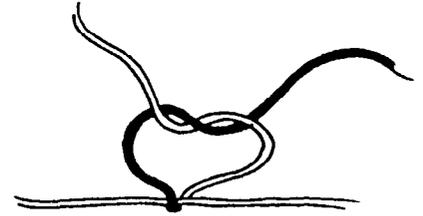


CONSERVATION BOOK REPAIR

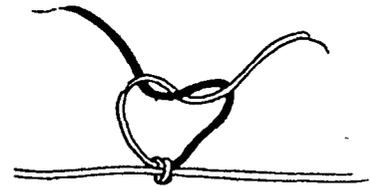
The Square Knot

Square knots are used to tie off sewing thread when resewing a text block or attaching materials into pamphlet binders.

1. Take one end of thread in each hand.
2. Pass the right-hand thread over the left-hand thread and through the loop. Pull tight.



3. The *original* right-hand thread is now on the left side. Place it over the right-hand thread and bring it through the loop. Pull tight. Trim the end of the original thread. **Do not cut the added thread.**



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F. SEWING NEEDLES

Using the right needle will make sewing easy and more successful.

Needles should be as small in diameter as possible, have a blunt point, and have an eye no larger than the shaft of the needle. If the sewing needle is much bigger than the thread used, it will make a hole that the sewing thread cannot fill up.

Many book suppliers advertise needles that are very large, sometimes much larger than the sewing thread. Leather harness called Egg Eye needles (#4) work very well with most thread and are available in leather shops. Sources are listed in the SUPPLY SOURCES list.