NORTHEAST DOCUMENT CONSERVATION CENTER

RESOURCES
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CONSERVATION PROCEDURES
7.3 Repairing Paper Artifacts

Why Repair Paper Artifacts?

Tears are repaired most often to improve the appearance of a torn paper artifact, to prevent a tear from lengthening, to keep fragments from separating, or to make an artifact safer to handle. Often tear repairs are part of a conservation treatment performed by a professional conservator, but sometimes owners or custodians of these materials choose to repair them themselves, especially when more elaborate treatment is not called for.

The generally accepted method of repairing tears and breaks in paper uses strips of thin acid-free paper adhered with a water-based adhesive that is acid-free, stable, and reversible. The following materials are recommended for the repair of documents, book pages, and other paper objects.

Papers

The preferred repair papers are made in Japan usually from *kozo* fibers. These papers (sometimes erroneously called rice papers) are manufactured in different weights with names such as *Sekishu, Tengujo, Kizukishi, and Usumino*. The fiber content of Japanese papers varies, with some containing fibers that are not of conservation quality. To be safe, only papers made of 100 percent *kozo, mitsumata, or gampi* fibers, or a combination of these, should be used. These Japanese papers are appropriate for repairs because they do not discolor or become brittle over time, and they have long, strong, flexible fibers that produce a lasting repair. The lighter-weight papers are especially suited to the repair of documents, since they are translucent and unobtrusive, and may not obscure the text of a document. Most conservators use strips of paper with torn rather than cut edges, because a frayed edge makes a less visible repair and is less likely to deform the paper.

Adhesives

Use of a proper adhesive is essential. Any adhesive used for mending paper objects must have the following properties:

Sufficient strength: It should maintain its adhesion for an indefinite period.

No tendency to discolor: It should not yellow, darken, or stain the paper to which it is applied.

Reversibility: It should be possible to remove the repair paper with moderate effort and no damage to the object, even after many years.

Few commercially available adhesives meet these criteria. Commercial library and wallpaper pastes may lose hold as they age, and they often contain harmful additives. Rubber cement and animal glues darken and stain. Several synthetic adhesives, such as "white glue," are very difficult if not impossible to remove once they have aged. Pressure-sensitive (self-adhering) tapes should be avoided. The adhesives on these tapes may cause staining over time and require toxic solvents and technical expertise for removal.

Pressure-sensitive tapes advertised as archival are available from commercial vendors. These are probably more stable than other similar tapes, but because their aging properties are not proven, they should be avoided for objects of value. They do become difficult to remove in time. The adhesives on commercial gummed tapes, which require wetting, are less damaging, but they may stain in time and are usually too strong and tend to deform the paper to which they are adhered. These tapes should also be avoided for objects of value. Commercial products in general should be avoided even if they are reputed to be safe, because their composition is subject to alteration without notice by the manufacturer. This year's nonstaining tape or adhesive may have a different formulation next year.

Starch-Based Paste

For many years conservators have favored homemade starch-based pastes. These pastes have stood the test of time, as they have been used for centuries by Japanese screen and scroll mounters. They are made most often from either rice starch or wheat starch. They are not made from flour, because flour contains potentially harmful impurities that may become irreversible in time. The starch obtained by refining flour is preferred.
There are numerous recipes for these pastes. One recipe for wheat starch paste follows:

1. Place one part of wheat starch and four parts of deionized or distilled water in a clean saucepan or the top of a clean double boiler.
2. Mix well and let stand at least 20 minutes.
3. If a double boiler is used, fill the bottom part with a small amount of water.
4. Place on medium high heat and cook, stirring constantly with a clean, nonmetallic implement.
5. When the paste begins to thicken, which may happen right away, reduce the heat and continue stirring.
6. Stir for about half an hour until the paste is thick and translucent, then remove from the stove. As it cooks and thickens, it will become more difficult to stir.
7. Continue stirring for the first few minutes of cooling, then transfer the paste to a clean, covered container for storage. Allow the paste to cool to room temperature before diluting for use.

Quick Wheat Starch Paste

University Products, a supplier of conservation materials, has published a quick recipe for wheat starch paste.[1] The advantage of this recipe is that small quantities of paste can be easily prepared. The paste should be strained before use.

Place one tablespoon of wheat starch in a microwave-safe container, add five tablespoons of distilled or deionized water, and place in a microwave oven. Microwave on a high setting for 20 to 30 seconds. Remove the paste and stir. Place back in the oven and microwave another 20 to 30 seconds. Remove and stir again. Continue this process several times until the paste is stiff and translucent. If larger quantities are made in the microwave oven, increase the cooking time between stirrings. Cool the paste before straining.

Straining, Diluting, and Storing Paste

Starch paste should not be refrigerated; cover and store it in a cool, dry place. It will keep for only a week or less. Some conservators recommend adding a preservative, but preservatives are toxic chemicals and they may affect some artist's materials. It is preferable to make paste in small quantities when needed. If paste discolors, grows mold, discharges water, or develops a sour smell, discard it immediately and wash the container thoroughly in extremely hot water, in the dishwasher if possible, to eliminate residues of mold. Avoid soap, which may contaminate the paste.

Before use, paste should be strained. A Japanese horsehair paste strainer works best for this, but similar, less expensive strainers may be used, so long as they do not have metal components that may rust and contaminate the paste. After straining, the paste should be diluted by brushing it against the bottom of a

container while gradually adding small amounts of deionized or distilled water until the desired consistency is achieved. If water is added too rapidly the past will separate into clumps, and it will be nearly impossible to regain a smooth consistency.

Different consistencies of paste are required, depending upon the particular mending task at hand. A consistency similar to heavy cream is appropriate for most mending, although thicker or thinner paste may sometimes be called for, depending on the strength of the mend needed or the amount of liquid that the document can tolerate.

Methyl Cellulose

Starch pastes require time to make and they can fail if they are not made or stored correctly. A simpler adhesive can be made from methyl cellulose, which comes in powdered form and is sold by viscosity. In general, the higher the viscosity, the more stable the methyl cellulose. Mix one rounded tablespoon of methyl cellulose with one half cup of deionized or distilled water. Let the mixture stand for several hours before use. It will thicken on standing but can be thinned to the appropriate consistency with water. Methyl cellulose may not be as strong as starch paste, but it should hold adequately in most applications. Methyl cellulose keeps well for several weeks and does not require a preservative.

Mending Procedures

Tearing Mending Strips

It is desirable for mends to have a soft, fibrous edge to avoid deforming or even breaking a fragile paper along a sharp edge. To tear mending strips, use a bone folder or similar tool to incise a crease in the mending paper along a metal ruler or other straight edge. Draw a line of water along the crease with a small, soft artist's brush or a ruling pen. Pull the strip away from the sheet while grasping it near the crease. Make strips of different widths to conform to different tears; one fourth inch, one half inch, and three fourths inch are the most useful. If a great deal of mending is planned, tear up a good supply of strips in advance.

Preparing to Mend

Prepare a work surface by covering a sheet of clean blotting paper with a sheet of nonwoven polyester such as Reemay or Hollytex to prevent the documents being repaired from sticking to the paper because of stray or extruded paste.

Begin by mending the largest tears in a document first. Align the tear with the correct under- and overlaps, as tears typically occur not with the sharp edge that a cut produces, but rather with beveled surfaces that may alternate between the front and the back of a sheet of paper. If any of the overlaps are sizable, they should be pasted, adhered, and dried as described below before applying the mending strip.

Applying the Mending Strip

Using pieces of an absorbent paper such as blotting paper as a substrate for pasting the mending strip, apply starch paste or methyl cellulose to a strip of Japanese paper with a flat brush similar in width to the mending strip. The blotting paper will draw out excess moisture that could cockle or stain the document. Then lift the strip with a tool such as tweezers or a needle and place it over the reverse of the tear with the pasted side against the document. If a document has text on both sides, place the mend on either the side where it will not cover text or the secondary side, if text cannot be avoided on both sides. Breaks in papers tend to pull apart when wet with paste. For this reason it is easiest to use strips not more than three or four inches long. For longer tears, several short strips may be applied and dried one at a time, placed end to end. Start with the termination of the tear; this usually means the edge of the sheet is mended last.

It takes practice to manipulate the thin, wet repair strips. Once the mending strip is in place, brush it into contact using a dry flat artist’s brush then lay a sheet of nonwoven polyester (Reemay, Hollytex) over the repair.

Drying the Mended Sheet

Weight the repair while it dries. Weighting ensures good adhesion and prevents cockling of the paper. Repairs may be weighted as follows. First place small pieces of nonwoven polyester (Reemay, Hollytex) over the area to be dried. Then place a square of blotting paper, followed by a piece of glass or Plexiglas on top of the blotter. Finally, place a weight on top of the glass. Small bags of lead shot, pieces of lead covered with cloth, or any other small, dense object may be used as a weight. One-pound fishing weights from sporting goods stores make excellent weights, provided they have at least one flat side to prevent rolling. The blotting paper square may be changed in a few minutes, but the repair should be weighted for one hour or longer.

A photographer's tacking iron, set at low heat, can be used to speed up the drying process. The tacking iron should never be applied directly to the document; place a piece of nonwoven polyester between the iron and the document. Pay close attention to the tacking iron; these tools can achieve temperatures high enough to melt polyester and scorch paper, and the temperature of one that is failing may spike just before it burns out. Moving the iron with an "ironing" motion does not dry a mend faster. Instead, shift the location of the document from place to place on the blotter substrate every 10–20 seconds to hasten drying. After using the tacking iron, weight the mended area for a few minutes while it cools to lessen cockling.

Hazards

When tears are overly complex or when they cross through image areas in works of art or text areas on documents, it may be wiser to leave this work for professional conservators experienced in carrying out more challenging work. Some hazards to avoid include fragile art or writing media that may be disturbed by the manipulation or the moisture required for tear repair, or staining, breaking, or creasing of papers that are fragile, degraded, or overly sensitive to moisture. Some old tears cannot be restored to their original shape, as over time sheets can change their shape to conform to the altered tensions produced by tears.

Repair is usually not indicated for parchment, which is not paper but made of animal skin. Parchment should not be confused with "parchment" paper. It always resists bringing old tears into alignment, as it is a stronger material that changes its shape due to the way its internal structure responds to environmental conditions, especially fluctuating relative humidity. Heat should never be used on parchment, as this will cause permanent damage.

For archival documents, the need to repair tears can sometimes be eliminated by simply placing the papers in archival-quality Melinex or paper folders.

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