

PAPER CONSERVATION CATALOGUE PROTOTYPE

25. Mending

Locally joining splits or tears or reinforcing cracks in a paper support using an adhesive material.

25.1. Purpose: To restore aesthetic unity of the sheet and to preserve its physical integrity.

25.2. Factors to consider before mending.

25.2.1. Character of the paper: weight, strength, absorbency, texture, color.

25.2.2. Nature and location of the tear: puncture, slit, overlap, straight, forked; at edge, in image.

25.2.3. Media condition and characteristics: possible problems with moisture, manipulation, placing face down.

25.3. Materials and equipment.

25.3.1. Adhesives. Chosen for flexibility, strength, non-contractibility, non-darkening and long term good aging characteristics and reversibility.

Adhesives, characteristics of (See 46. Adhesives)  
Adhesive Recipes (See 46. Adhesives - Appendix).

A. Aqueous Adhesives can be applied directly to tear edges and/ or applied to a reinforcing paper strip.

1. Starch pastes. Wheat or rice are in common use. Also potato, cornstarch, arrowroot.

2. Cellulose ethers. Methyl cellulose, carboxy methyl cellose are in common use. Also hydroxy ethyl cellulose, hydroxy propyl cellulose.

3. Proteinaceous adhesives. Gelatine, parchment size. For possible use with parchment (likely to darken or discolor paper).

- B. Non-aqueous adhesives are applied to a carrier to make heat set or pressure sensitive mends.
1. Acrylic emulsions (e.g. Rhoplex, Plextol).
  2. EVA emulsions (e.g. Elvace).
  3. PVA resin (e.g. Hot Melt - PVA- AYAA + AYAC).
  4. BEVA 371.
    - a. Heat set.
    - b. Webbed for pressure sensitive application by spraying with compressor. BEVA will gel before contacting reinforcing paper.
  5. Commercial preparations (e.g. Filmoplast, Promatco adhesives). Sometimes used by conservators for temporary mends. A danger lies in not knowing all ingredients in proprietary formulations.

25.3.2. Reinforcing paper strips. A reinforcing paper strip with applied adhesive generally forms the mending material. Considerations: weight, strength and quality of reinforcing paper material; width of strip; whether paper reinforcement is needed at all.

- A. Japanese tissue paper is chosen for its freedom from impurities, flexibility, and long fibers. A particular tissue is selected for its compatibility to the design support paper (generally the tissue is lighter weight).
1. very thin (e.g. gampi, tosa, tengujo).
  2. thin (e.g. kizukishi, kanaryoshi, udagami).
  3. medium (e.g. sekeishu).
  4. heavy (e.g. okawara, uda).
- B. Lens tissue is short fibered and not very strong. It can be used when fiber length is not critical. It is most often used with non-aqueous adhesives.

25.3.3. Materials and equipment for preparation and application of mend.

A. Surface to paste out on:

1. Smooth surface with good release properties(e.g. polyester film, silicone release paper).
2. Absorbant surface (e.g. blotters).

B. Brushes to apply paste:

1. Stiff, short bristled - for controlled application of thin adhesive layer to reinforcing strip and for ensuring firm contact between mend and support.
2. Thin, soft, pointed - for applying adhesive to tear edges.
3. Stipple brush - for tapping mends into place.

C. Tweezers.

D. Light box.

25.3.4. Materials and equipment for drying and flattening mend.

A. Blotters: to draw moisture out of mend.

B. Release material: silicone release paper, polyester web, polyester film. Generally placed between blotter and wet mend to prevent sticking.

C. Air gun, tacking iron: for faster drying.

D. Weights, plexiglas, glass, blotters, felts: for flattening.

25.4. Mending - Treatment variations

25.4.1. Conventional mending with aqueous adhesives.

Object should be cleaned prior to mending with care taken to clean in and around the area to be mended. Adhesive application, especially aqueous, will set grime and may emphasize tear edges. (See: 16. Dry Cleaning; 17. Washing: local aqueous cleaning; 21. Enzymes)

If tear remains soiled, some conservators recommend teasing out fibers along tear edges. A needle point can be used to soften and feather edges which are hard, dirty or encrusted with adhesive. For grimey tears that resist all other cleaning some advocate removing the dirtiest edge fibers. Others feel that this compromises the integrity of the support.

As an alternative, overlays of thin paper or pulp may be desired to cover very dirty mends. (See 26. Filling and Compensation: pulp fills)

A. Align Tear.

Confirm that both design elements and tear edges match up. Confirm that flaps along tear edges overlap properly.

Placing an object on a light box may help assure that alignment is maintained during mending. Others find it advantageous to align edges and mend, at least initially, with the drawing face up. To mend object face up, a pasted out Japanese tissue strip is tacked with adhesive to a piece of polyester film which is used to maneuver the strip into place beneath the tear. When dry such mends will help hold the tear in alignment for further mending.

B. Adhere tear edges.

Direct application of adhesive to tear edges. The wet adhesive (starch paste or cellulose ether) can be applied directly to tear edges and flaps. Polyester film or other material might be inserted between torn edges to protect the underlying side from adhesive before the actual join is made.

C. Prepare paper reinforcing strips.

1. Grain direction of reinforcing strips.  
Paper strips can be torn with or against the grain. Considerations: matching grain direction of strips to grain direction of object support; increasing mend strength across a tear by having strip grain perpendicular to tear direction.
2. Torn-edge mend reinforcing strip. Most common in paper conservation. The feathered edges diffuse the mend boundaries and lessen chances of creating a bulge in the support. They also provide additional strength across the mend.
3. Mending strips with cut edges. When large numbers of tears need mending and when cut edges will not create ridges on the recto, mending strips can be cut with a ruler and scalpel, scissors, etc.
4. Multiple strips are prepared in advance by Japanese mounters. They take long narrow strips of paper ( e.g. 2 by 12 inches) and fold them in half (e.g. 2 by 6 inches). Closely spaced parallel cuts (ca. 5 inches long) are then made in the folded edge, leaving about one inch uncut at the other end. When unfolded the result is many narrow cut strips held together at the ends by one inch bands which can be removed when the strips are needed.

D. Apply adhesive to reinforcing strips

1. Adhesive is applied to strip with a stiff brush, brushing outwards from the center of the tissue to splay the fibers.
2. Adhesive can be brushed onto the reinforcing strip on any smooth inert surface such as polyester. If moisture may cause problems to the support, adhesive can be applied to the strip on a blotter to absorb any excess moisture.

E. Apply paper reinforcing strip over tear.

1. When the paper strip is applied to the tear, fibers are again brushed outwards to ensure contact.
2. Scroll type mend. Japanese scroll mounters find it fast and convenient to wrap long pasted repair strips on a spiral around a tool or brush handle, and then to unwind the desired length along a tear or crack.

D. Drying aqueous adhesive mends.

1. Use blotters to absorb moisture from mend while weighting damp area to prevent cockling of the support and contraction of paste layers. Polyester web or other release materials are important initially to prevent accidental adhesion.
2. When fast drying is desired, e.g. to prevent water staining or for convenience, use heat from a hot air blower or from a tacking iron applied to a protective cover blotter strip.

25.4.2. Mending paper easily discolored by aqueous adhesives.

Proceed as in 25.4.1, but omit step applying paste to tear edges. Tear is only held together by pasted reinforcing strip. This approach might be appropriate for paper that discolors with any direct adhesive application to tear edges.

25.4.3. Mending tears with alignment problems.

A. Align Tear. Some old tear edges may have sprung from uneven expansion and contraction, creating a gaping tear or preventing design elements from meeting correctly.

1. Manipulate the dry paper into alignment. Sometimes the dry paper can be manipulated into alignment and mends applied gradually, checking alignment as each area is joined and dried.
2. Hold tear in correct alignment with weights. It may be necessary to realign tear using weights to hold a torn paper in as nearly a correct position as possible while applying adhesive and reinforcing strip, and while mend dries.
3. Use moisture to locally expand paper. An area which is to be expanded relative to another might be wetted (with brush, moist blotters or spray) and weighted in the expanded position to stretch the paper slightly. The area should be carefully observed to make sure that it is not under excess stress, which can extend the tear or create new tears.
4. Use heat to locally contract paper. An area which is to be contracted relative to another might be wetted and dried with a warm air gun. A series of such manipulations may help align the tear.

5. Temporary mends may be needed to maintain the alignment or keep a gap closed in preparation for permanent mends. These mends may use aqueous, pressure-sensitive or heat set adhesives. They are applied at points along a tear to hold it in the correct position while permanent mends are being applied. The mended tear might not lie flat but can be relaxed and flattened locally or overall afterward.

The temporary mend may be applied to the recto (avoiding design areas) or the verso. If placed on the verso, temporary mends are removed before the permanent mend reaches that point. Mends on the recto can be removed after the entire permanent mend is made, but prior testing should be used to assure that the adhesive in no way alters the surface. Some fear that any adhesive placed on the front surface may alter the long term aging characteristics of the paper in that area.

25.4.4. Mending tears in paper with single fiber reinforcements.

Single Japanese fibers are useful to bridge tear edges for an object with image on recto and verso. Proceed as for 25.4.1, but omit reinforcing strip. Single fibers of Japanese paper can be teased off with a needle point from a pasted out bit of paper. The slight amount of paste on the fiber will adhere it. Apply so as to bridge tear edges on both or either recto and verso, according to location of design. Fibers can be teased from papers toned with non-aqueous colorants if off-white fibers are too noticeable.

25.4.5. Tab mend to mend inaccessible tear edges.

When verso is not directly accessible, reinforcing strip is inserted from recto to verso. One half of tissue tab is pasted out, inserted beneath one tear edge, pressed into contact, and allowed to dry. The second half is then pasted out (on a protective slip of polyester film) and manipulated beneath the other side of the tear. Particularly useful with three-dimensional or permanently lined objects.



- 25.4.6. Mending with internal reinforcement strips.  
Where the paper support is amenable (i.e. a laminate structure) and if it is necessary to camouflage a mend from both sides of an object, the support paper can be split and a pasted reinforcing strip inserted to join the two sides of the tear. The split edges are then readhered to the reinforcing strip and allowed to dry flat.
- 25.4.7. Closing a gaping tear.  
A tear may pull together if reinforced with a paper such as gampi which contracts greatly as it dries.
- 25.4.8. Mending a ridged tear. Tear edges which lift into a raised ridge can be mended with double-layered repair strips: a narrow strip directly reinforcing the tear, a wider strip overlying the narrow one. Alternately a very contractile reinforcing strip of gampi may pull the edges flat.
- 25.4.9. Mending a tear with a very thin, skinned flap. A non-contracting adhesive such as methyl cellulose (or a 50:50 mixture of paste and methyl cellulose) will help prevent puckering of the thinned flap and is less likely to discolor the thinned area.
- 25.4.10. Mending with acrylic emulsion heat set tissue.
- A. Align tear. (See 25.4.1)
  - B. Prepare reinforcing paper
    - 1. Coat adhesive chosen onto Japanese paper or lens tissue and allow solvent to evaporate. (See: Hey and Waters for method in use at Library of Congress. This coated paper is also sold by some conservation suppliers.)
    - 2. Shape coated heat set tissue:  
Score with stylus and ruler and tear along scored line. Alternatively, wet with acetone, ethanol or other appropriate solvent and then tear along wetted line to create feathered edge. Tissue can also be rolled into a tube and ends sliced off to create strips.
  - C. Apply heat set tissue with coated side to surface of object and tack with tacking iron.

- D. Clarify the heat set tissue. Tissue can be made more transparent after application by treating with acetone or ethanol or solvent appropriate to the adhesive system.

25.4.11. Mending with BEVA 371 heat set tissue.

- A. Align tear. (See 25.4.1)
- B. Shape reinforcement strips prior to coating if feathered edge is desired, otherwise cut coated tissue to shape.
- C. Brush on BEVA diluted to consistency of maple syrup. Allow solvent to evaporate.
- D. Apply uncoated side to object to minimize adhesive penetration of object.
- E. Apply heat sparingly through silicone release paper. Overheating may drive the adhesive into the paper.

25.5. Mending - Bibliography

(See 46. Adhesives: Bibliography)

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Compiled by: Nancy E. Ash  
Kitty Nicholson

May 1984

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22. Humidification

Introduction of moisture directly or indirectly into the design and/or paper support.

22.1. Purpose

Conservation of support to realign paper fibers in order to reduce sheet distortions such as cockles, strain or rolling; realign deformations in the sheet such as creases, folds and ridges; reestablish original configuration of the paper, such as original flatness, platemark or embossing.

Conservation of media to consolidate pigments by reviving aqueous binders; relax dessicated gums and resinous lakes, etc. Restore moisture content of solvent treated papers. Soften support so that a new dried configuration can be achieved. Relax sheet in preparation for dry-lining or washing, or suction table work, or expand sheet for stretch drying with edges weighted or confined.

22.2 Factors to consider when deciding whether or not to humidify and in choosing humidification technique

22.2.1. Sensitivity of Support and Media\*

- A. Sensitivity of inks, dyes, media, gums, paper coatings, surface finishes to vapor or liquid moisture\*
- B. Paper hygroexpansivity\*
- C. Inherent memory of paper which might be necessary to retain plate mark and/or embossing: hard, calendared surfaces may disturb the surface of some modern papers\*

22.2.2. Tendency of support or media to water stain\*

- A. Presence of foxing spots\*
- B. Presence of active mold: mold can be expected to proliferate in a humid environment\*
- C. Presence of adhesive residues: when damp the adhesive may be reactivated or possibly move through paper support\*

\* This subject requires expansion.