



Article: An evaluation of quillwork and hair stabilization methods used at the National Museum of the American Indian

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Source: *Objects Specialty Group Postprints, Volume Eight, 2001*

Pages: 166-180

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AN EVALUATION OF QUILLWORK AND HAIR STABILIZATION METHODS USED AT THE NATIONAL MUSEUM OF THE AMERICAN INDIAN

Elizabeth Brown

Introduction

During the recent treatment of approximately 45 Plains Indian shirts in the conservation laboratory of the Smithsonian National Museum of the American Indian (NMAI) we evaluated and developed several techniques for the stabilization of quillwork and hair locks. The treated shirts were selected for display in an exhibition *Beauty, Honor and Tradition: The Legacy of Plains Indian Shirts*. The exhibition, curated by NMAI's George Horse Capture and his son Joe Horse Capture, a curator at the Minneapolis Institute of Art (MIA) opened in New York in December 2000 and is scheduled to travel to the Minneapolis Institute of Art in 2002. The intent of the exhibition was to illustrate the beauty of the shirts and to portray the history, cultural context and development of the shirts. Therefore in developing treatment methods we took into consideration the need to stabilize the shirts for travel and for exhibition on mannequins, to maintain the historical integrity of the shirts, and to improve the aesthetic of the pieces as requested by the curators.

The shirts incorporate a large variety of styles and materials, and many contain bands of woven quillwork and quill-wrapped hair locks with varying degrees of damage and deterioration. Many quills are broken or lost due to mechanical and insect damage. Hair loss was caused both from brittle hair breaking and loose hairs slipping out of the wrappings. As a result of the differing demands of the shirts, a shortened exhibit timetable, mannequin requirements, and the diverse group of people working on the project, we investigated a variety of techniques for the stabilization of these damages. The following is a description and critique of the quillwork repair techniques used, some established and some new.

Part I - Quillwork Repairs

Adhesive Choice

After comparing solutions and films of Acryloid F-10, Jade 403 and Acryloid B-72, we selected Acryloid B-72 as it had the best characteristics for quillwork repair. The adhesives, tested by NMAI interns Melinda McPeck and Shannon Parker, were chosen for their stability and their ability to create strong flexible films. Both strength and flexibility were important as the shirts would be manipulated during fitting for the mannequin installation, travel, and de-installation. The testing methodology involved adhering small painted strips of Tyvek to the ends of dyed quills as this was the most common method of repair (see below). While all the adhesives created flexible films, all except the Acryloid B-72 failed when the bond was flexed and/or pulled slightly.

Brown

Application of Adhesives

Depending on the method of repair, several different techniques can be used for applying the adhesive. Evaluations of the strength and flexibility of the repairs was done by simple manual manipulation.

Cast Acryloid B-72 film

- A small puddle of 40% w/v Acryloid B-72 in xylene or toluene is placed on Teflon sheeting between two strips of paper tape. A glass slide is then drawn down over the two tape strips producing an even film approximately 1mil thick after solvent evaporation. When dry another layer can be applied. In most cases two to three layers provides the best working characteristics. Both xylene and toluene films were used in this project and no obvious difference in flexibility was determined. Six months after this project unused sections of these films remained flexible with only slight stiffening. (For more extensive research on the subject see Hansen1995)
- A miniature square is then cut from the cast Acryloid B-72 film and placed with tweezers between the broken quill and Tyvek bridge (or an adjacent quill).
- The quill is pressed down and a tiny drop of 3:7 xylene:acetone* is fed into the adhesive with either a syringe or brush to re-activate the film.

Acryloid B-72 solution applied with a syringe or brush.

- A drop of a 30% w/v solution of Acryloid B-72 in 3:7 xylene:acetone* is applied between the quill and Tyvek bridge with a syringe or brush.
- By sticking the syringe needle through the plastic lid of a small empty container when it is not in use, drying of the adhesive bead on the end can be prevented.
- The quill is then pressed down and held (or clamped) until the adhesive sets.

*Initially pure acetone was used in these applications. However, as some of the repairs failed during initial mount fittings, xylene was added to the mixture in an attempt to gain a stronger more flexible bond. (See comparison of solvents below.)

Comparison of Adhesives and Application Techniques

- The strength of the repair appears to be the same for both the film and solution

Brown

application of the adhesive.

- The Acryloid B-72 film is a neater application and allows a faster tack time than direct application of Acryloid B-72 with a syringe or brush.
- In re-activating films, personal preferences outweighed any particular merit of solvent application with either a brush or syringe. Many found the syringe difficult to control but others felt that with practice it was more efficient and controllable than the brush.
- The solution takes longer to set than the reactivated film and usually requires light clamping. (Films will usually grab if held for a few seconds and thus do not usually require clamping.)
- Light weights or clamping increases the bond strength with both films and solutions.
- Direct application of the solution is usually faster repair method. If many quills need to be set down, the syringe works better than the brush as the latter tends to get a large buildup of adhesive.
- The reactivated film method can be difficult as the little squares tend to slip out of place, pop out of the tweezers and generally get misplaced.

Comparison of solvents

- Acryloid B-72 films cast with xylene, toluene, or xylene and acetone mixtures appear to remain more flexible than those cast with pure acetone.
- When the Acryloid B-72 is applied directly in solution, the repair appears to remain stronger with xylene/acetone solutions than simple acetone solutions. Xylene, however, increases the set time and thus often requires clamping.
- Films re-activated with 3:1 xylene:acetone appear stronger than those re-activated with acetone alone.

Tyvek Bridges

Overview of Technique

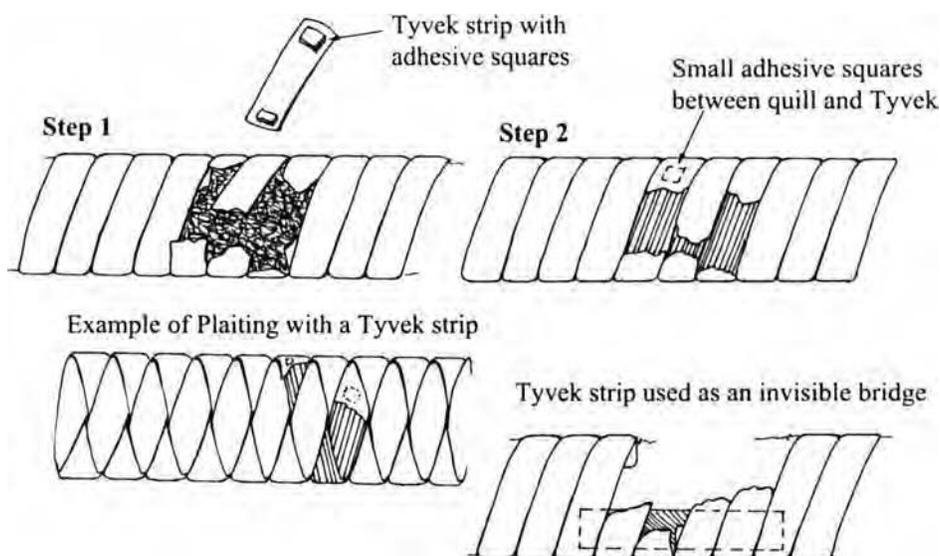
Narrow strips of toned Tyvek are used in this well established technique to replace missing quills and to stabilize broken ends. In some instances a simple bridge is made between the two extant ends and no attempt is made to fill the adjacent losses. In other cases large areas can be re-woven

Brown

to fill and visually re-integrate the entire area of loss. Adhesive methods using both Acryloid B-72 films and solutions applied directly with a syringe or brush were tested.

Method of application

Sections of heavy weight Tyvek (#1025D) are toned with acrylic paints to imitate the missing quills. If desired the gloss can be increased using either a thinned solution of Acryloid B-72 or an acrylic gloss medium. The toned Tyvek® is then cut into strips the width of the original quills and adhered to the end of the broken quill with either Acryloid B-72 film, Acryloid B-72 in a syringe or Acryloid B-72 applied with a brush as described above.



Findings

- This method works best for areas where only a few quills are broken and missing. Very large areas where complete re-plaiting was attempted often became bulky in appearance and was extremely time consuming.
- With frequent handling, the bridges tend to fail at the adhesive joint. Many of the bridges needed repair during the frequent fittings on the mannequins and during installation. However this may have been in part due to incomplete setting of the adhesive as very little failure occurred during de-installation.
- Light pressure or clamping after the initial grab increases the strength of the joint.

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- The technique is visually satisfying as the toned Tyvek successfully imitates the missing quills.
- The fills are identifiable with close examination and are easily reversible.

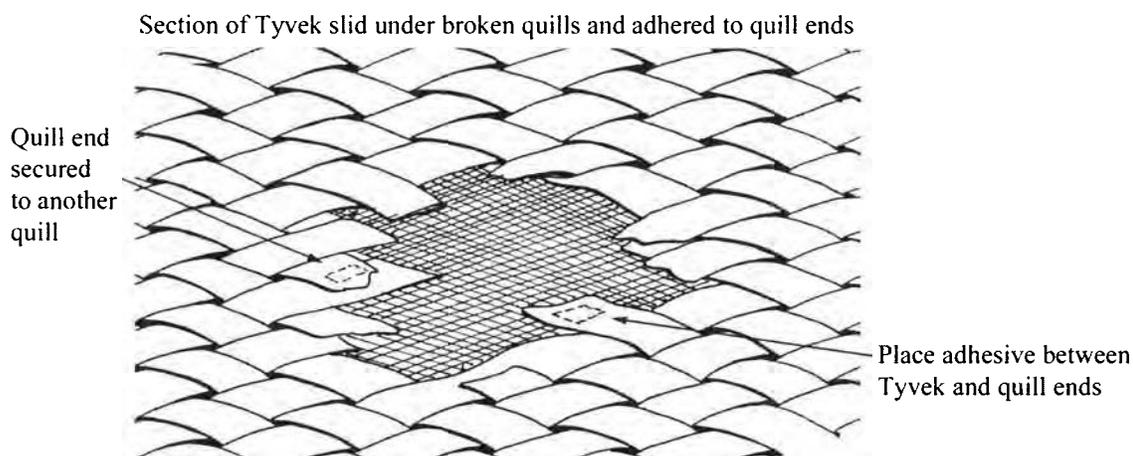
Color Field

Overview of Technique

For this technique solid pieces of toned Tyvek are used to stabilize and visually re-integrate relatively large areas of quill loss. As no attempt is made to replicate and re-weave the individual missing quills the technique is very useful for re-integrating large areas of loss.

Method of application

Heavy weight Tyvek is toned with acrylic paints to blend with the adjacent quillwork. It helps to drag a comb or stiff brush across the wet paint to impart the impression of the woven quills because flat color fields do not integrate well (technique fine-tuned by Melinda McPeck). The toned Tyvek is then placed under the extant broken quill ends and held in place using either tiny cut squares of Acryloid B-72 film or Acryloid B-72 in solvent applied directly as described above.



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Findings

This method effectively stabilizes the extant quills and avoids the problem of Tyvek bridges “popping” apart.

- In large closely woven areas this method can be effective as it avoids some of the bulky appearance problems which can occur with the Tyvek bridge method.
- Although the technique was developed to avoid the time intensive process of re-weaving, we found that in actuality it is not extremely time efficient because it is difficult to produce a large fill that appears visually satisfying.
- These fills are easily identifiable and removable in the event the repair needs to be reversed in the future.

Reemay Fills

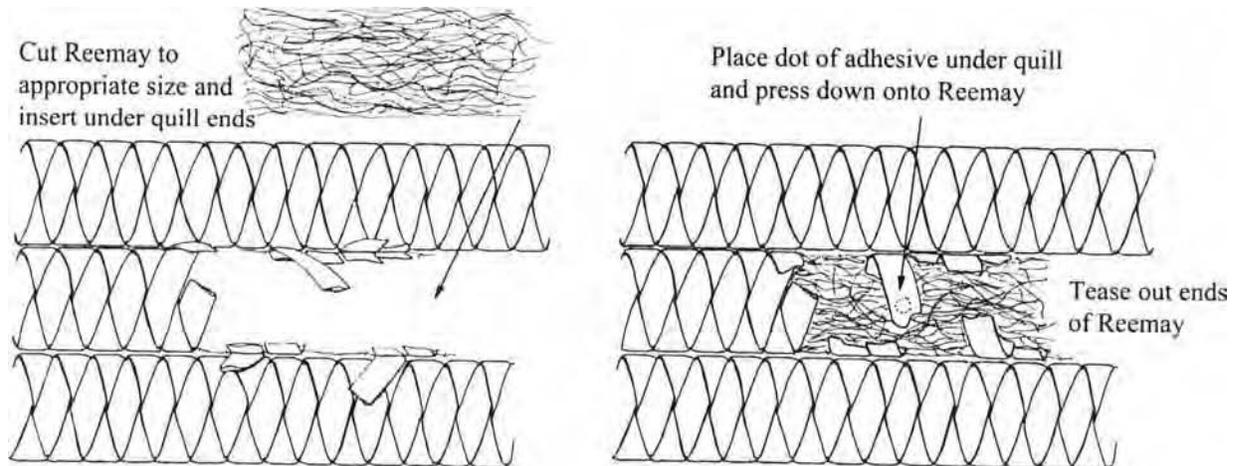
Overview of Technique

Reemay, toned to blend with the hide substrate behind the quillwork band, is used to stabilize large areas of quill loss where only small fragile ends of the quills remain. The damaged quills are adhered to a Reemay insert instead of the hide in order to make the repairs more reversible and avoid staining of the hide with adhesive. Both heavy and lightweight Reemay were tested. This is a stabilization method that makes no attempt to visually re-integrate the losses.

Method of Application

Sections of Reemay are toned to the color of the hide with thinned acrylic paint. The best results are achieved when a porous material such as blotter paper or paper towels is placed under the Reemay during painting to absorb the excess paint and avoid filling the interstices of the fabric. The Reemay is then cut to the shape of the loss and exposed edges are teased out. The toned Reemay is placed under the broken quill ends and adhered to them using a viscous (~40% w/v) solution of Acryloid B-72 in acetone. This solution allows the adhesive to set before it seeps through the porous fabric and adheres to the hide below.

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Findings

- Like the color field technique, this method effectively stabilizes the extant quills and avoids much of the problem of small bridges “popping” apart.
- Visually it blends convincingly with the hide. However it does not visually re-integrate the areas of quill loss.
- This method is the most time efficient of all those tested.
- The repairs are identifiable with close examination and they removable in the event the repair needs to be reversed in the future.
- The lightweight Reemay was preferred in most cases as it blends more effectively with the hide.
- Exposed edges of the lightweight Reemay can be effectively disguised by teasing out the fibers and intermingling them with the hide fibers beneath the fill.

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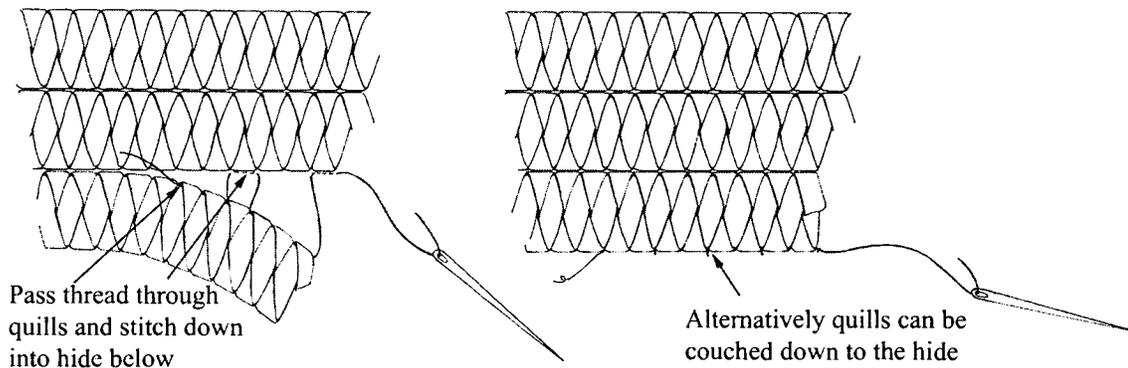
Restitching

Overview of Technique

Fine polyester thread is used to secure areas where quillwork bands are still intact but the stitches holding them in place have broken or pulled out of weakened hide. The thread is passed through the folded edge of the quill band and then down into the hide to stitch the lifting and in some cases precariously hanging bands of quillwork back down to the hide substrate.

Method of Application

A strand of a fine tan polyester thread (Skala) is threaded through the quill bands and stitched down into the hide below every 4-5 quills or when necessary. Where the hide is in good condition a couching technique similar to that originally used to hold the quills in place can be used. However, in instances where the hide is very deteriorated and friable, large running stitches are necessary to prevent the stitches from simply pulling out. Hair silk can also be used, but it tends to catch and break frequently and cause unnecessary damage to the hide and quills.



Findings

- This system holds the quill strips securely in place.
- The tan colored fine thread is invisible at a distance of a few inches.
- This method can be time intensive and difficult to execute in areas where the hide is extremely degraded.

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- Although the repair is reversible in that the stitches can be cut and removed, new holes (from the beading needles and monofilament) were made in the hide as the original holes were torn and could not be re-used.
- The technique avoids the possibility of staining the hide with an adhesive.
- Hair silk was also tested but it tended to break easily and catch inside the quill bands.

Part II - Hair Lock Repairs

Adhesive Choice

Acryloid B-72 in xylene and acetone mixtures was used for the repairs below with the exception of the first example where adhesive is not used at all. This mixture was chosen as many of the repairs will be difficult to reverse in the future and this adhesive has been shown to be one of the most stable (Down 1996). All of the following applications were performed under magnification.

Hair Silk

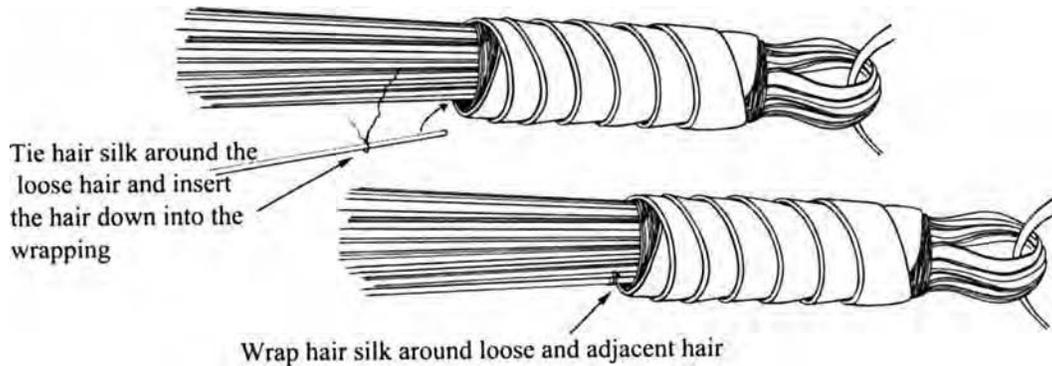
Overview of Technique

This technique secures the detached hair back into the hair lock with hair silk. As it avoids using an adhesive, this is the most easily reversible of the techniques used.

Method of Application

A strand of hair silk is tied around the end of a hair detached from the hair lock. The hair is then slipped down into the sinew wrapping at the base of the hair lock as far as possible and secured in place by wrapping the ends of the hair silk around the detached hair and an adjacent hair. In some instances it is possible to simply slip the hair down into the sinew wrapping and then wrap the hair silk around this and an adjacent secure hair at the same time. However this second method tends not to hold the detached hair as securely.

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Findings

- When only one hair is broken and the extant hairs are not brittle, this method can be effective.
- It is difficult to get the silk tied tight enough to prevent slippage without breaking the tied hair.
- The repair is invisible at a distance of a few inches.
- Of the three techniques tried, this is the most time intensive.
- This is the most reversible stabilization technique.

Adhesive Coated Hair Silk

Overview of Technique

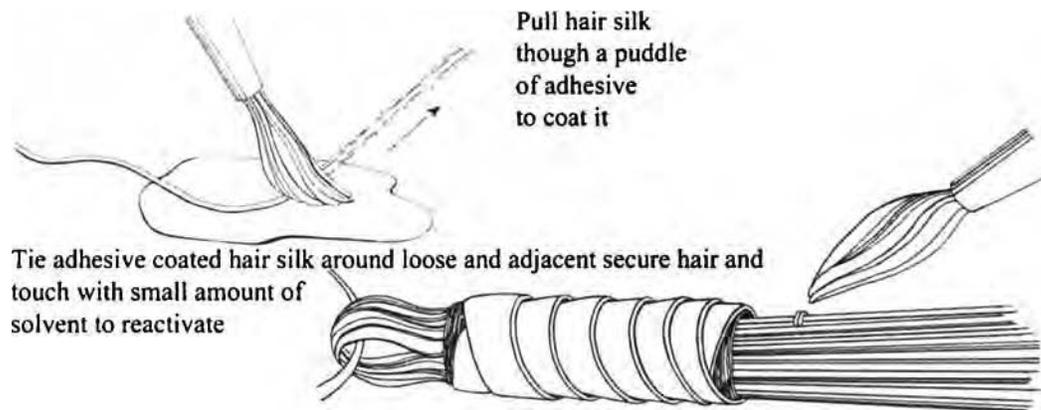
Hair silk, with an adhesive coating applied to increase the hold, is tied around broken and secure hairs in order to secure the loose ones in a hair lock. The adhesive is reactivated after the hair is secured to provide a light and easily reversible bond between the silk tie and the original hairs.

Method of Application

A strand of hair silk is pulled several times through a small puddle of an approximately 30% w/v solution of Acryloid B-72 in 3:7 xylene:acetone. When the thread is covered with a light, barely visible coat of adhesive it is taped to the edge of the table and allowed to dry evenly. The

Brown

detached hair is then slid down into the base of the hair lock, the adhesive coated thread wrapped around the loose hair and an adjacent secure hair several times and then knotted. A small drop of acetone is applied to the area to reactive the adhesive and secure the silk wrapping to the hairs.



Findings

- This method is extremely effective in re-attaching broken hairs without damaging the extant ones, as the threads do not need to be pulled very tight.
- In some cases many hairs can be attached at once by weaving the thread over and under broken hairs.
- As only a very thin layer of adhesive is used, the repair is discreet and invisible at a distance of a few inches.
- Like the previous methods, it is extremely time intensive.
- Reversibility tests indicated that only a light nap bond was achieved between the adhesive and the hair. Thus when solvent was reapplied and the adhesive thread removed, very little (no visible) adhesive remained behind on the hair.

Dipping

Overview of Technique

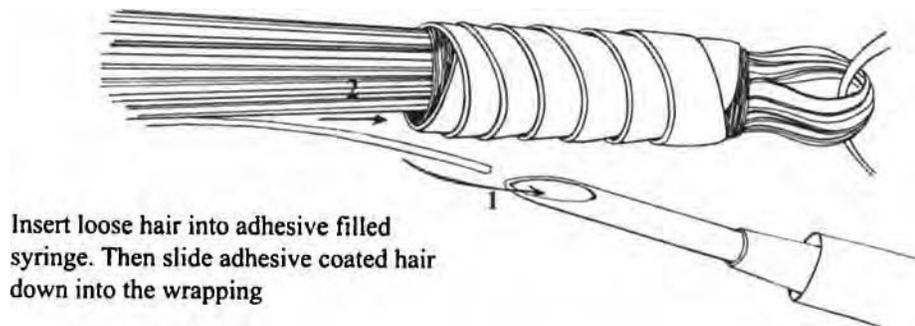
This method rapidly secures many broken hairs by coating the ends of the hair with adhesive and pushing them down inside the sinew wrapping of the hair lock. As the hairs are often entangled

Brown

in the locks and removing them can be difficult and can possibly cause unnecessary damage, the system of dipping the hairs into a syringe was developed.

Method of Application

A syringe fitted with a fairly large sized needle (16G) is filled with a %15 w/v solution of Acryloid B-72 in 3:7 xylene:acetone. It is then held near the broken hair and the broken hair is slid a short distance into the needle to coat it with adhesive. The adhesive coated hair is then removed and quickly slid down into the sinew wrapped base of the hair lock.



Findings

- The system does not require manipulation of the adjacent hairs and thus avoids breakage of brittle but still intact hairs.
- The repairs are invisible.
- This method is by far the most time efficient.
- It is not as reversible as the other techniques as it is virtually impossible to determine which hair was broken and it would be difficult to remove the adhesive from down inside the wrapping.

Brown

Conclusion

In treating these shirts we found that a variety of techniques were necessary in order to accommodate the varying stability of the quills and hair, the nature of the loss, the aesthetic needs of the shirt, and exhibit schedule. The large number of conservators working on this project enabled many innovative ideas to be brought to the project and successful solutions developed while revisiting established techniques and developing new ones.

Acknowledgments

Project Manager: Monika Harter

Staff Contributors: Jessica Johnson, Marian Kaminitz, Susan Heald, Kelly McHugh

Fellow Contributors : Dominique Cocuzza, Ellen Roblee

Intern Contributors: Mary Coughlin, Sarah Kitch, Travis Lane, Nancy Love, Melinda McPeck, Shannon Parker, Heather Richardson

Materials

3M Scotch Long-mask Masking Tape (Treated blue crepe paper with synthetic adhesive.)

3M Industrial Tape and Specialties Division, 3M center, Building 220-7W-03, St. Paul, MN
1-800-722-5463. www.3M.com

Acryloid (Paraloid) B-72 (An acrylic co-polymer of 70% ethyl methacrylate and 30% methyl acrylate, T_g 40° C.)

Available from Talas, 568 Broadway, New York, NY 10012. 1-212-219-0770 and
Conservator's Emporium, 100 Standing Rock Circle, Reno NV 89511. (702) 852-0404.
(formerly Conservation Materials Ltd. Of Sparks NV).

Disposable Syringe and Precision Glide Needles (Becton and Dickinson, green #21G 25mm, purple 16G 38mm, stainless steel and polypropylene.)

Fisher Scientific. P.O. Box 1768. Pittsburgh, PA 15230 or 3970 John Creek Court Suite #500 Suwanee, GA 30024 (www.fishersci.com)

Golden Polymer Medium, Gloss (100% acrylic polymer emulsion.)

Conservation Support Systems, P.O. Box 01746, Santa Barbara, CA 93190-1746.
1-800-482-6299.

Hair Silk (100% silk thread, imported from France, used in textile repair. The same thread is used to weave silk crepe line. Natural color, two strand.)

Talas, 568 Broadway, New York, NY 10012. 1-212-219-0770.

Brown

Plain Microscope Slides (Pre-cleaned 25mm x 75 mm x 1mm glass slides.)

Fisher Scientific. P.O. Box 1768. Pittsburgh, PA 15230 or 3970 John Creek Court Suite #500 Suwanee, GA 30024 www.fishersci.com

ReemayTM (Porous, spun bonded non-woven polyester fabric made from long continuous fibers of 100% Dacron.)

Talas, 568 Broadway, New York, N.Y. 10012. 1-212-219-0770.

Skala thread (Fine semi-translucent polyester sewing thread produced by Gütermann in

Germany.) U.S. distributor: Testfabrics, P.O. Box 26, 415 Delaware Ave., West Pittston, PA 18643. 570-603-0432. www.testfabrics.com and www.guetermann.com

Teflon Coated Fiberglass Sheeting (Premium 6mil sheeting.)

Chemfab Corporation, Water St., P.O. Box 476, North Bennington, VT 05257, USA
Tel. 802/447-1131, 1-800-243-6322

TyvekTM (Synthetic paper made from olefin, manufactured by DuPont. 100% high density fine white polyethylene fibers as continuous filaments bonded by heat and pressure with no binders or fillers.)

Avery Dennison, 250 Chester St. Painesville, OH 44077

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