Compensation for small losses to lacquer and inlaid decoration using paper fills painted and glazed \textit{in situ}

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This paper describes and illustrates an innovative technique for compensation of small losses to East Asian lacquer and inlaid mother-of-pearl decoration using paper fills painted and glazed \textit{in situ}. The procedure involves tracing the loss on Mylar\textsuperscript{®} polyester sheet, cutting Japanese tissue paper to the size and shape of the loss, and adhering the paper fill to the surface. The paper fill is then painted \textit{in situ} to integrate it with the surrounding surface decoration and glazed with a transparent medium, which is cured under silicone-coated Mylar\textsuperscript{®} to match the planarity and gloss of the surrounding surface. This basic procedure can be adapted to suit the needs and solvent sensitivities of individual objects. The technique offers the ability to preserve or adjust old fills and to match an irregular surface or surface decoration. It is easily reversible and gives the final surface a semi-translucent appearance. Moderate表面 stability and solvent resistance in the surrounding lacquer are necessary for the technique. The case studies presented in this paper demonstrate that the technique yields good results and is a useful addition to the arsenal of options for lacquer compensation.

Keywords: Lacquer, Inlay, Treatment, Loss compensation, Paper fills

Introduction
There are numerous compensation methods for losses to lacquer objects utilizing a range of materials from lacquer or synthetic resins to paper (Webb, 2000, pp. 84–95; Hatchfield et al., 2014). However, many of these methods require abrasive or other physical methods to match the surface finish of lacquer and can be difficult to reverse. This paper describes and illustrates an innovative technique for compensation of small losses to lacquer and inlaid decoration using easily reversible painted and glazed paper fills to replicate the surface finish with minimal interaction with the surrounding surface. The technique can be tailored to the solvent sensitivities of individual objects.

Basics of the technique
The basic steps of the technique are illustrated in Fig. 1. A shaped paper fill is made by tracing the loss onto Mylar\textsuperscript{®} polyester sheeting (a), transferring the tracing from Mylar\textsuperscript{®} to Japanese tissue paper (b), and cutting the paper to the size and shape of the loss (c). Japanese tissue paper of similar thickness to the depth of the loss can be chosen to fill shallow losses, or multiple layers of paper can be laminated to fill deeper losses. The shaped paper fill is then placed into the loss (d), adjustments made if necessary, and adhered to the lacquer surface using an appropriate adhesive (e). The fill should ideally be slightly recessed from the surface when adhered so that the final painted and glazed fill will be in-plane with the surface.

Once in place, the paper fill is painted \textit{in situ} to integrate it with the surrounding surface decoration (f). To match the planarity and gloss of the surrounding surface, the painted fill is then glazed with a transparent medium that allows the silicone coating (g). Finally, after the glaze has cured, the silicone-coated Mylar\textsuperscript{®} is peeled off and any spillover glaze extending beyond the paper fill onto the lacquer surface is removed with solvent (h). This basic procedure can be adapted to suit the needs of individual objects by tailoring the choice of adhesive, paint, and glazing medium to the solvent sensitivities of the lacquer surface. The practical implementation of the technique is illustrated in the following case studies.
Case study 1

A seventeenth- to nineteenth-century Chinese lacquer presentation box (MFAB 11.10583a-b; Fig. 2) with a complex figural scene in the collection of the Museum of Fine Arts, Boston, USA, had distracting losses in the inlaid mother-of-pearl design and large sections of lifting inlay, likely due to the inherent strain of an inflexible inlay material on a flexible substrate that responds to changes in temperature and relative humidity (RH). The losses showed traces of iridescent mother-of-pearl and incised patterns within clearly defined, shallow, recessed areas (Fig. 3). Some of the inlay remained embedded in lacquer around the edges, indicative of a decorative technique in which the shell was glued to a prepared lacquer surface and covered with additional layers of lacquer, which were then ground and polished away to reveal the inlay (Webb, 2000, pp. 43–44; Shon, 2013). This process would originally have given the inlaid decoration a glossy, uniformly planar surface, now altered due to delamination and loss of inlay.

Treatment

The goal of the treatment was to improve the legibility of the design by setting down lifting inlay and compensating for the lost inlay without overly reinterpreting the original design. It was decided by the curator not to compensate for the figures’ faces, as fills would have obscured the incised features still evident in the lacquer. The mother-of-pearl itself was extremely thin (less than half a millimeter), translucent and iridescent with a wide variation in color. The fill material needed to replicate these features, as well as the gloss and planarity of the original esthetic. A shaped paper fill painted and glazed in situ was found to be the best solution because of the shallowness of the losses and wide variation in color. Paper is also a flexible material that would not cause damage to adjacent mother-of-pearl inlay or the lacquer substrate as it

Figure 1 Steps involved in making a paper fill: (A) loss traced onto Mylar®; (B) shape transferred to Japanese tissue; (C) tissue cut to shape; (D) tissue placed into loss; (E) adhered in place; (F) tissue color matched in situ; (G) fill glazed under silicone-coated Mylar®; and (H) the Mylar® is peeled off when dry and any excess glaze is removed from around the completed fill.

Figure 2 Presentation box, Chinese, seventeenth to eighteenth century, lacquer on wood with inlaid mother-of-pearl, gold and silver decoration, William Sturgis Bigelow collection, Museum of Fine Arts, Boston (MFA) 11.10583a-b. Photograph © 2016 Museum of Fine Arts, Boston.
responds to fluctuations in RH. In addition, the individually cut fills were sympathetic to the original inlay technique. Painting the fills in situ allowed them to match the colors and characteristics of the adjacent inlay without the distracting contrasts that could result from using mother-of-pearl to fill the losses. The clear glaze over a painted surface gave the fills a semi-transparent appearance, allowing them to mimic the thin mother-of-pearl inlay.

Once the technique was chosen, the solvent sensitivities of the surface were tested to determine the appropriate adhesive and glazing medium. Despite the extent of lost inlay, the lacquer itself was in good condition and not sensitive to polar solvents, including acetone and ethanol. The ability to use polar solvents allowed for the use of a large range of adhesives. It was found that a strong, quick-setting adhesive was needed to lay down delaminating inlay, and 10% (w/v) Paraloid® B-72 acrylic resin in acetone proved the most effective. To remain consistent, this adhesive was also used to adhere the paper fills. The fills were then painted in situ with Golden® Interference Colors, acrylic paints that would not dissolve the adhesive below and would imitate the iridescence of the mother-of-pearl.

To match the gloss of the polished inlay, the painted fills required a glazing medium that was transparent when dry, remained soluble in polar solvents, and would not solubilize the acrylic paint. Golden® Porcelain Restoration Glaze, a waterborne acrylic coating that dries glossy and clear, fits these requirements and was brushed over the painted fills. Silicone-coated Mylar® was laid on top of the wet glaze to ensure that the film would take on the smooth, flat surface of the Mylar® when cured. The glaze was allowed to cure for several days and the Mylar® was peeled off, leaving a smooth, flat surface with an occasional pit left by an air bubble. If the cavities left by air bubbles trapped under the Mylar® were large or noticeable, they could be filled with more glazing medium and again be allowed to cure under silicone-coated Mylar® until a completely smooth surface was achieved. Because the fills were slightly recessed in the surface, the majority of the glaze was contained within the area of loss; however, in some cases it overflowed onto the lacquer surface. Spillover glaze was removed from the lacquer surface with acetone and cotton swabs after it cured and the Mylar® was removed. Once cured, the Mylar® was peeled off the glazed fills, leaving a flat, glossy surface similar to that of the original inlay (Figs. 4 and 5).

While greatly improving the legibility of the decoration with fills that matched the color variation, semi-transparent appearance, and flat glossy surface of the original inlay, the treatment presented some challenges. The minute scale of some of the fills required that the placement and painting of the fills be done.
with the aid of a binocular microscope. If mistakes were made during the painting step, the thin Japanese tissue proved too fragile to withstand removal or adjustment of the painting. In this event, the entire fill had to be removed and a new shaped fill was cut and adhered. While this was a frustrating occurrence, it highlighted the ease of reversibility provided by this technique.

Case study 2
A piece of Asian red lacquer refashioned into a tray for a French eighteenth-century Rococo inkstand (JPGM 76.DI.12; Fig. 6) in the collection of the J. Paul Getty Museum, Los Angeles, USA, had sustained abrasive damage from the feet of a gilt-bronze candelabrum mount. It was found that the candelabrum had been positioned incorrectly before the piece came into the collection, exacerbating the damage. The damage resulted in losses of variable depth. There were deep losses in some areas where the mount had abraded away the friable lacquer and part of the wooden support. In other areas the damage overlapped old wax fills, producing very shallow losses. The tray itself had lacquered and gilded decoration depicting a floral arrangement in a basket. There had been a number of previous restorations including wax fills

Figure 5 Enlarged details of MFA 11.10583a-b: (top) before treatment; and (bottom) after treatment. Photographs © 2016 Museum of Fine Arts, Boston.

Figure 6 Inkstand (encrier), unknown artist. Early 1700s–1750. Hard- and soft-paste porcelain; Asian lacquer on coral tree wood; gilt-bronze mounts. 20.3 × 35.6 × 26.7 cm. The J. Paul Getty Museum, Los Angeles. 76. DI. 12: (left) fully assembled; and (right) the lacquer tray before treatment.
and overpaint on the gilded decoration. Analysis of a cross-sectional sample indicated that the lacquer was of Asian origin with the addition of a varnish layer, likely a later European addition (Schilling et al., 2012). The interventions and restorations gave the lacquer tray a slightly distorted surface with uneven red coloration in some areas.

**Treatment**

In order to restore the tray's ability to function as a support for the other components of the inkstand, the lacquer needed to be consolidated, the losses filled, the decorative surface matched, and the mount repositioned to prevent further damage. The presence of the old wax fills presented a challenge as they had sustained some damage, did not match the surface decoration well, and were harder than the surrounding lacquer. Therefore, the wax fills were left in place and modified with shaped paper fills that were painted *in situ* to match the surface decoration and varied coloration.

The presence of both Asian and European lacquer at different levels of the piece resulted in different solvent sensitivities for the surface and the lower layers. The surface was sensitive to most polar solvents but stable with water, while the lower layers remained unaffected by ethanol. These solvent sensitivities limited the options for consolidants and adhesives used on the lower layers of lacquer to those that could be dissolved in water or ethanol. Possibilities for glazing media needed to be soluble in water alone, be transparent when dry, and be hard enough to support the gilt-bronze mount when the piece was reassembled. Aquazol® 500, a water soluble polyoxazoline with a high molecular weight, was chosen as the consolidant, adhesive and glaze, changing the concentration and solvent to that best suited for each function.

As the lower layers were less solvent sensitive, a 10% (w/v) solution of Aquazol® 500 in a 1:1 mixture of ethanol and deionized water was used to consolidate the friable lacquer surface. The addition of ethanol allowed for better penetration of the consolidant. For shallower losses, a template of the loss was traced on Mylar® and used to cut a *gampi* Japanese tissue fill that was then adhered to the surface with the same 10% Aquazol® 500 solution. In this case, the addition of the ethanol allowed for better wetting when adhering the paper to the old wax fills. In the gilded areas, the paper fills were painted to match the decorative surface with Golden® Fluid Acrylic Paints and mica powders in 10% (w/v) solution of Aquazol® 500 in a 1:1 mixture of ethanol and deionized water. Finally, the fills were glazed with a 40% (w/v) solution of Aquazol® 500 in water and allowed to set under a layer of silicone-coated Mylar® over several days. The higher concentration of Aquazol® 500 did not quickly resolubilize the mica powders, making it an effective glazing medium.

For deeper losses, a more complex procedure with a combination of fill materials was used (Fig. 7). After the adjacent lacquer was consolidated, a layer of *gampi* Japanese tissue shaped to fit the losses was adhered with the 10% Aquazol® 500 solution described above to act as a barrier layer. The losses were then filled to a level slightly below the lacquer surface with Flügger®, a commercial fill material consisting of calcium carbonate in an acrylic binder that provides more structural support than paper. The Flügger® fills were smoothed and polished with...
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...damp cotton swabs and increasingly finer grades of Micro-mesh™ cushioned abrasive cloths. They were then toned dark red to mimic the coloration of the lower lacquer layers. Mylar® templates were then traced from the toned fills, and used to cut a second gampi Japanese tissue fill that was adhered, painted, and glazed in the same manner described above. The recessed areas of loss contained the glazing medium and thus there was no need to remove excess glaze. However, in one area the smooth fill appeared anomalously pristine next to the distorted lacquer surface and its appearance was modified with water and cotton swabs to be less uniform and distracting.

The use of painted and glazed paper fills was particularly suited to this treatment because of the need to modify old wax fills and replicate the surface decoration. The ability to tailor the technique to the solvent sensitivities of the individual layers of lacquer was another asset. The flat, glossy surface produced by the painted and glazed fills provided an excellent visual match for the red lacquer under a clear varnish (Fig. 8). Thus treated, the tray could once again function as a support for the components of the inkstand and the piece was reassembled with the candelabrum in the correct position.

Conclusion

The use of shaped paper fills offers the ability to preserve or adjust old fills by overlaying a paper fill, to combine with other fill materials and techniques, and to laminate multiple layers of paper to fill deeper losses. Painting the fills in situ makes it possible to match an irregularly colored surface or surface decoration, and glazing the fills under silicone-coated Mylar® gives a glossy, flat, semi-translucent appearance. However, the technique is not able to reproduce true translucency and is best suited for inlays and highly pigmented lacquer that is mostly opaque. The planarity of the glazed surface also becomes distorted when attempting to compensate for areas of loss larger than a two centimeters square, making the technique primarily useful for small losses. However, this limitation could be overcome through further experimentation and refinement of the technique. Overall, the technique requires minimal physical interaction with the surrounding surface. While it requires moderate surface stability, it can easily be tailored to the solvent sensitivities of an individual object. The ability to customize the technique to suit the needs of individual objects is a great asset, making the technique, in part or in total, readily adaptable for use on a variety of media in addition to lacquer and inlaid material.

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List of suppliers

Aquadro® 500: Polymer Chemistry Innovations, 4231 South Fremont Avenue, Tucson, AZ 85714, USA. <www.polychemistry.com>

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Paraloid® B-72: Rohm and Haas, 100 Independence Mall West, Philadelphia, PA 19106, USA.

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