Preservation Practices

by Hugh Phibbs

Creating Sealed Enclosures

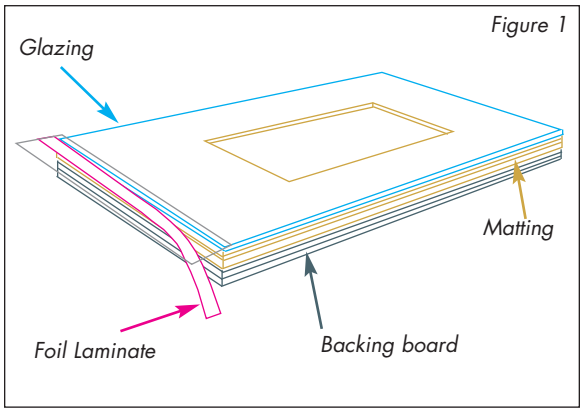
Framers, especially those who focus on preservation, are likely to be presented with requests for frames that can protect vulnerable items from dangerous climatic conditions. When owners insist on displaying works on damp walls, in rooms with water sources like fire sprinklers, and in buildings that are periodically unoccupied, they require special treatment to provide protection for their holdings. What can be done to minimize the danger in such requests? And can a framer in a private shop make truly sealed frames?

By understanding the appropriate techniques, preservation framers can make practical waterproof packages that will work well for years

Answering these questions requires an understanding of such products as glazing materials, composite sealing foils, matboards, tapes, and polymer boards as well as a thorough sense of the challenges posed by climate extremes. You must start with materials that provide a barrier, those that function as atmospheric filters, and ones that provide a reservoir to take up to give off water vapor. You need to know about the crystalline or near-crystalline materials needed to create barriers to gases, since such materials must stop simple molecules.

Barrier Materials

An effective barrier to such harmful gases requires something that is crystalline or functions like a crystalline material, since each atom in a crystal is linked to neighboring atoms to form a solid barrier. While many crystals are hard and brittle, the search is easier when you consider that metals are crystalline. Metal sheets and foils can



be found in different sizes and thicknesses, which make them prime candidates for use in enclosures designed to protect valued items from climate extremes.

Among the metals that might be considered for the creation of a barrier layer, aluminum is the most cost effective, least corrosive, and lightest in weight. Raw aluminum will oxidize, turning from bright silver to a dull, dark gray, and the oxidized product can come off and contaminate items it touches. For this reason, the most useful forms of aluminum are those that resist oxidation: powder coated, anodized, and lined with a polymer film. The first two are found in furniture and frames but are not often found in rolled sheet form.

The last form is available in rolled sheets in many varieties. Polymer-coated aluminum foil is widely used in the packaging industry. Packaging products commonly are found in puncture-resistant layers, bonded to polyethylene, which is bonded to an aluminum layer, which is bonded to yet another layer of polyethylene. It is this second, inner polyethylene layer that forms a heat-sealable bonding layer and makes these products useful.

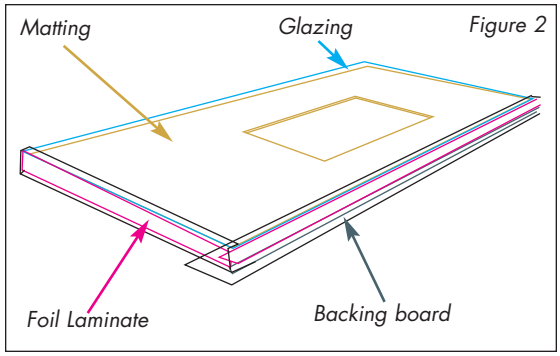
Other products can also be useful to a preser-

vation framer. One is silica gel. Few materials have been as thoroughly misunderstood. Silica gel is silicon dioxide (like glass or sand) that has been altered so that it is riddled with tiny cracks. The surface on either side of these cracks is polar and so forms a weak polar bond with water. This means that silica gel functions as a highly efficient sponge, taking moisture from air that is damper than it is and giving moisture to air that is drier than it is. It should not be considered simply a desiccant or a humidity reservoir, although it will serve as both depending on how it is conditioned.

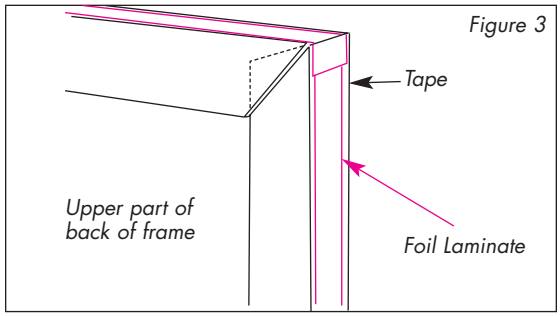
In museums, silica gel is used in short-term settings to raise or lower the conditioning of slightly leaky enclosures. If an enclosure is air tight, silica gel is superfluous. And if an enclosure is very leaky, it cannot maintain the desired conditions. This means that it is unsafe to include in a frame that may be in a setting that is too wet or too dry unless conditions within the frame are monitored and the gel is changed when conditions warrant.

This kind of maintenance is not usually expected of a homeowner, so it is wiser to rely on the conservation quality board to modulate the climate and leave high capacity materials like silica gel to institutions. (If an owner is willing to monitor the conditions within a frame, there is one described below that allows ready opening and closing for replacement of old silica gel.) And the only form that can be easily handled is a silica gel impregnated sheet, which can be found at preservation suppliers.

The conservation quality board that is normally used in window and back mats is an effective climate buffer, even though it is does not have the capacity to take up and donate water vapor like silica gel does. Since these boards are likely to contain calcium carbonate and perhaps zeolites, this board offers protection against air pollution, while silica gel simply takes up pollutants and re-emits them later. In addition to serving as a reservoir for water vapor, conservation board filters out dust and provides support for paper items that respond to changes in climate.



Other materials commonly found in frames are sheets used as glazing and as backing boards. Glass is classified as semi-crystalline, since the crystal structure of silicon dioxide is interrupted by potassium or sodium. But it is so highly crystalline tat framers can also regard it as a vapor barrier. Acrylic and polycarbonate sheet, on the other hand, will take up water vapor and allow it to pass through. This has two important implications. First, no plastic glazing material should be expected to function as a vapor barrier, and any enclosure that includes it should be regarded as leaky to vapor. If it is properly sealed, it can be expected to exclude liquids only. Secondly, if a package uses



plastic glazing material, that package should not be expected to perform well if the outside conditions become too dry. When that happens, the outside of the glazing will give up moisture to the outside. As it dries, it will shrink, causing the acrylic to bend inward toward the framed item. This can result in contact between the glazing and the framed item. If a frame is shipped in this condition, the item may abrade the plastic and abraded plastic may contaminate the framed item.

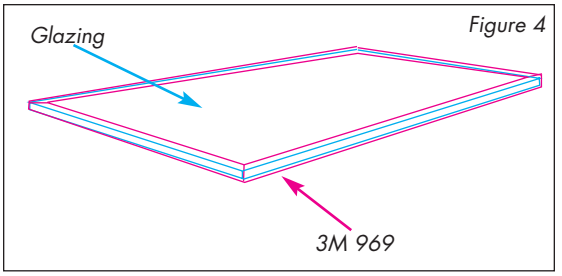


Figure 4

Making Enclosures

With these limitations in mind, how can these materials be used to make frames that are more protective? Heat-sealing foil can be used to create enclosures that block harmful emissions from wood and other framing materials and as a barrier to isolate frames from damp walls. Those available today include Marvelseal 360, Metallized Polyester, and RIBS/MVTR. The first two are made of aluminum, polyethylene, and either nylon or polyester. The third is more elaborate. Its outer layer is polyester, with a bonding layer of polyethylene, and then a layer of aluminum. On the inside, where other films have only a heat-sealing layer of polyethylene, this product has a layer of static-dispersing, carbon-laden polyethylene and an innermost layer of polyethylene impregnated with expanded copper that is the key component of the Corrosion Intercept technology. The first two products can be found at preservation supply houses, like University Products, while the RIBS/MVTR material can be found at Hollinger/Metal Edge.

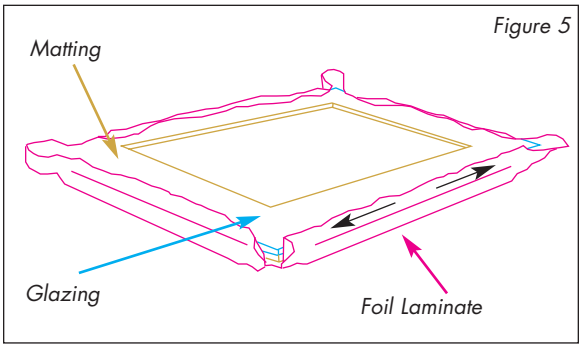


Figure 5

Any of these films is a vital component in preservation framing since they can be bonded to frame rabbets or the back of fillets, using nothing more that the proper degree of heat to form an effective barrier to the peroxides and acids that wood emit. These foil laminates can be ironed to themselves to make useful pouches for the storage of books, pamphlets, and matted items. These pouches can also have their open ends folded over several times before being taped shut to form an effective vapor barrier.

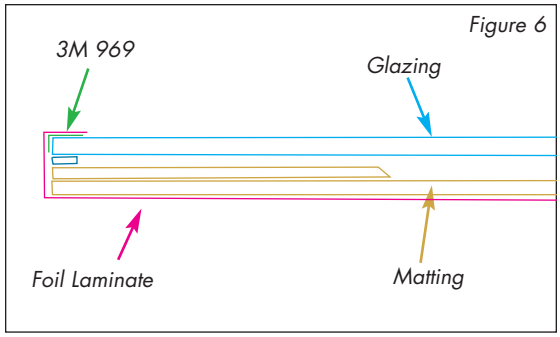
The most effective use of these barrier foil materials, however, lies in blocking emissions that come off pressure-sensitive tape used to make waterproof packages to defend framed items from water from a broken sprinkler head. Wet pipe fire suppression systems are widely used in public buildings in case of fire. Unfortunately, the heads on such systems are fragile. If bumped with a ladder or other tool, they can spray high-pressure water for two hours. To defend against such accidents, a simple package can be made with thin package sealing tape, a strip of heat sealing foil, glazing sheet, and an all polymer backing board.

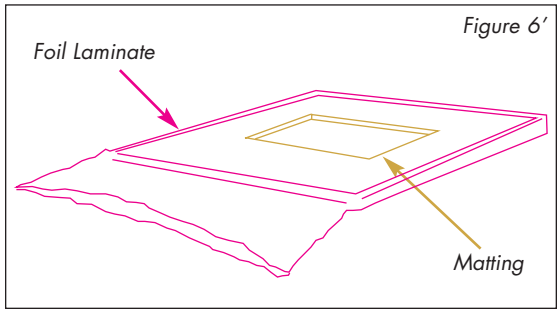
When an item and its matting, cleaned glazing, and backing board have been assembled, a strip of package sealing tape, such as 3M 371 0, can be applied to the front edge of the glazing along the bottom side of the mat. This strip of tape should be as long as the bottom edge of the package, and the strip of sealing foil should be applied with the polyethylene side toward the adhesive side of the tape (Figure 1), along the entire bottom edge. When that is done, the tape and blocking foil laminate can be pulled to the back of the package, where the tape can be adhered to the back of the back mat.

The same process can be done with the sides and top of the package, with the following changes: the tape on the sides will begin at the top corners of the package and will extend beyond the bottom corners. The blocking strip will also begin at the top corner and extend around the bottom corners, but not as far as the tape. This ensures that the blocking layer will protect the bottom corners and that the tape will seal the ends of the blocking layer along the bottom of the package (Figure 2). Similarly, the tape that is attached to the top of the package will extend around to the upper portion of the sides, and the blocking layer will too but will not extend around as far as the tape does.

Since this package is designed to survive wetting, the folding pattern used to close the corners of the back of the package is critical. If the sides of the tape at each corner are folded from the bottom up and then in from the side, the resulting fold at each corner will be open along the bottom edge and will be closed at the top (Figure 3), which will keep water from collecting there if there is an accident involving water. The tape should be burnished tight when the package is complete to enhance its water resistance.

This package should provide good protection for a few years, but no tape can be expected to hold over the long run. Tapes that have a metal layer in them, behind or outside the adhesive, should last longer, since the adhesive will be protected from oxidation by the metal layer. A true long-term seal can only be assured if some form of mechanical pressure is applied.





Completely Sealed Enclosures

A good example of completely sealed enclosures can be seen in the housings that protect the U.S. Constitution and Declaration of Independence at the National Archives and Records Administration in Washington, DC. Since these documents are kept within public view, they are sealed in oxygen-free enclosures to prevent light damage to the documents. These enclosures are glazed with low-iron laminated

glass that is clamped onto gaskets made of indium metal, which is set along the front of the boxes in which the documents rest. These boxes are made of solid blocks of aluminum that have been hollowed out and anodized. Since these packages are rigid, they had to be tested to the failure point of the glass to demonstrate how they would react to a drop in pressure during severe weather. These enclosures cost millions of dollars and represent the state of the art.

That said, what can a typical preservation framer reasonably be expected to accomplish given the economic and technical limitations of the market? Any long-term enclosing display package must include glass. Since low-iron, laminated glass is far more expensive than most clients' budgets, relatively safe alternatives are necessary. The strength of a lite of glass is proportional to its thickness, but the iron content of window glass makes thicker lites too green. However, four-mil low-iron glass is relatively safe and is visually excellent. This product may require contacting glazing dealers that handle architectural glass, but it is well worth seeking out for a discerning client.

A long-term sealed enclosure must begin with properly conditioned contents, matting materials, and artwork. You can determine the condition of these components by placing them in a polyethylene bag with a cobalt salt indicator card for at least an hour. If the materials are too dry, they can be made more humid by adding a sheet of blotter paper or matboard slightly dampened on one side (and placed away from the conditioning materials). If the contents are too damp, a sheet of blotter or mat board that has been desiccated with heat can be added to the polyethylene bag. For most shops that have air conditioning, the shop should

run in a relatively safe range most of the year, and the staff will be able to feel overly damp conditions that may occur in the muggy part of the summer and overly dry conditions that can develop during the heating season. These impressions can be verified with a cobalt salt card affixed to a workroom wall.

When matting materials are in proper condition and the art is secure, they can be set on the polyethylene side of a sheet of heat-sealing foil that is an inch or two larger than the materials' exterior dimensions. The glass should be cleaned, and a strip of high tack ATG, such as 3M 969, added to the front and side edge of the glass (Figure 4). Then the clean glass, with the added ATG, is fitted onto the face of the matting. When that is complete, the covering paper can be removed and the foil laminate pulled up and pressed onto the ATG, starting at the centers of the sides and proceeding toward the corners (Figure 5). More strips of ATG should be added to the inside (polyethylene side) of the foil laminate, which allows the two sides of the laminate to be pressed together to seal the corners. The ATG will stick to the polyethylene, but it will stick better to the other, outer layer of the laminate. For short-term packages, it is more effective to use the laminate with the inner (non-polyethylene) side inward. To establish the longest lasting bond possible, however, heat should be used to bond the polyethylene side to the ATG.

To complete this enclosure, heat should be applied to the outside of the foil laminate with a household or tacking iron, heating the laminate until it becomes wrinkled and flattens onto the ATG, showing that it is thoroughly bonded. Care must be taken when the corners of the package are ironed to ensure that the laminate is flat and that there are no gaps. This seal benefits from the fact that the metal layer in the laminate protects the adhesive, which limit its oxidation. Applying pressure from the outside, as it in the case of a back-loading metal frame, will also add to the longevity of the bond.

Where and for how long should such an enclosure be expected to remain sealed? There is no simple answer, but it mostly depends on the conditions outside of the package. Conditions that are very hot or cold can degrade a pressure-sensitive adhesive. The adhesive will ooze when it is too hot and will shrink when it is too cold. This is true of most adhesives, which accounts for why they are seldom preferred for conservation/preservation settings.

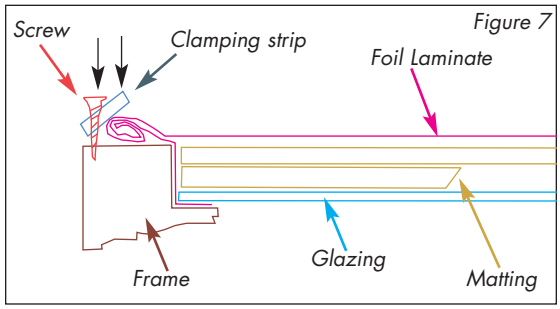


Figure 7

Monitoring Enclosures

Since it is impossible to depend on even a package like this one to function indefinitely, framers with clients who insist on locating vulnerable items in unstable climates can be given the choice of monitoring a sealed package that can be opened for the replacement of silica gel that has gone off peak conditioning. The simplest way to monitor it is to include a small strip of cobalt salt card, cut lengthwise, under the foil at the edge of the package (Figure 6). This can be done so that the strip will hide behind the rabbet of the frame for the ordinary viewer but will allow those who know where to look to see it through the edge of the glass. This design eliminates the extra work of adding a second window at the back of the package.

If the owner of a framed item is willing to monitor and maintain an enclosure, it is possible to employ a strategy similar to the Park Service approach, with properly conditioned silica gel added to the package when it begins to go off its optimal conditioning. To do this, two things are needed: silica gel sheet and a means of opening and closing the package that is relatively easy. Silica gel is available from preservation supply houses in sheets that are usually 18" square, and each sheet should be able to condition the air in a package that is a good deal larger than the sheet itself. The package can be made with a modification that involves an opening that can be folded shut and clamped tight at the bottom of the package.

This enclosure begins with a complete sheet of sealing foil that will be heat bonded to the high tack ATG on the front of the glazing sheet. The foil laminate at the bottom edge is 3" to 6" longer than the foil on the other three sides. The top and sides of the enclosure are secured and heat bonded, but along the bottom edge another strip of foil laminate is pressed onto the ATG that has been applied to the glazing edge. This strip should be wide enough to extend from within the edge of the glazing and as far out as the extended laminate on that side (Figure 6). This strip will be heat bonded to the glazing edge and then to the neighboring foil laminate, where the two meet. Suitable joints can be made by folding the added

piece and the neighboring edge together and applying heat from above. Since an opening is being created to allow properly conditioned silica gel to be substituted for an existing sheet, this aperture doesn't have to be as wide as the side of the enclosure from which it extends.

When the seams are secure, well-conditioned silica gel can be carefully inserted behind the matting material and the extended side can be tightly formed into a roll, beginning at its outer margin. This roll can be temporarily secured with a strip of tape. The package can be installed in the frame, and the rolled portion can be set against the back of the frame and squeezed tight with a strip of rigid material (metal, polymer, or wood) that can be screwed tight to the frame back, pulling the clamping device down onto the roll. When the conditions within the enclosure drift out of their proper range, the package can be opened, the old gel sheet removed, and well-conditioned sheet inserted, and the package rolled shut and secured with the screw down clamping member (Figure 7).

That same laminate material can also be used to back the frame itself when a frame will be near a damp wall to ensure that moisture is kept from entering the back of the frame. The most enduring bond of this laminate material to the back of a frame can be made with a bead of hot melt adhesive laid on the back of the frame, so that the laminate can be heated and bonded to that glue, when the frame is completely fitted. This will not seal the front and sides of the frame. However, it will improve the chances that the contents of the frame will be affected more by the air in a room and not the air from a damp wall behind the frame. Some framers have used Tyvek—flash-spun polyethylene—as a backing material. While it is a good barrier for dust and liquid water, it is not designed to be a barrier to water vapor and won't protect the contents from such dampness.

Developing Your Techniques

Using these techniques, preservation framers can make practical waterproof packages that will work well for years. Completely sealed packages will hold their condition as long as the glass and seal remain intact. The heat sealing laminate foil that enables the creation of such packages can also be used to seal wooden framing components to counter the danger of potential emissions.

The tools and techniques are readily available, but to employ them successfully you need to study the climate of a shop throughout the year to know its condition in any season. You must make test packages and monitor them using cobalt salt cards, and you must practice making these sealed packages extensively before offering them to your clients. At the same time, your clients must be educated on how to monitor enclosed items. The bottom line is that any technology like sealed enclosures inside frames will work well only if they are maintained. ■

Hugh Phibbs, preservation editor, is the coordinator of preservation services in the Department of Exhibitions and Loans, Conservation Division, National Gallery of Art, Washington, D.C. He has taught workshops for The National Conference, the AIC, PPFA, conservation programs at Winterthur/University of Delaware, and the Smithsonian Resident Associates Program. He also compiled the matting and framing section of "The Book and Paper Group Outline."