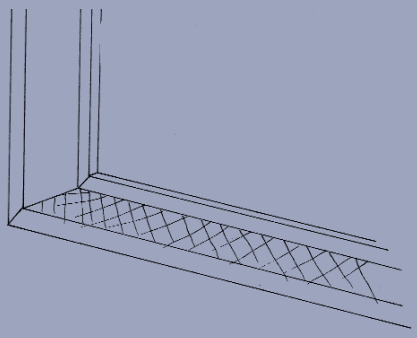


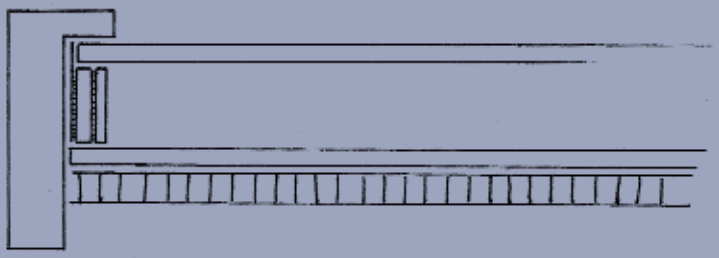
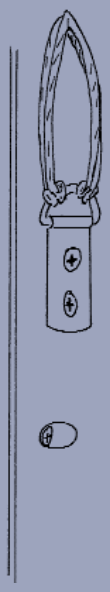
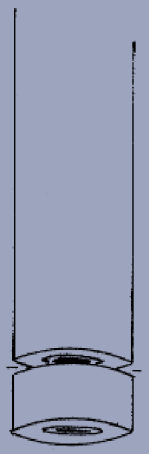
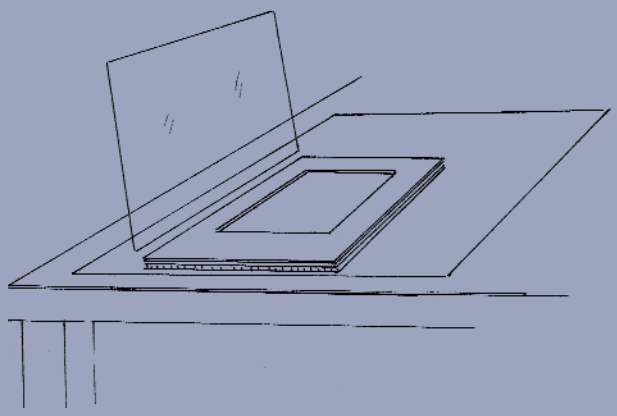
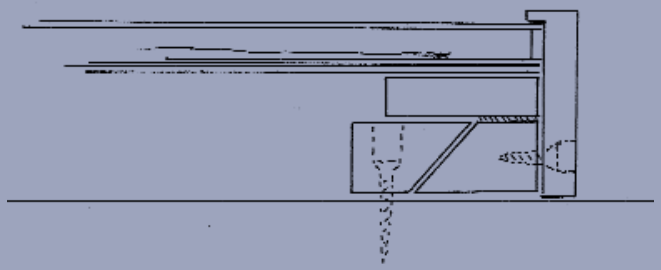


TABLE OF CONTENTS









The Frame: A Complete Preservation Package

by Hugh Phibbs

Framing Works on Paper Before the Twentieth Century

The picture frame is a physical border which separates and mediates between the world depicted in a work of art and the world which we inhabit. Frames have been protecting paintings from physical abuse and enhancing viewers' appreciation of them for over a thousand years. Artworks on paper, however, were not framed until glass (initially created for architectural purposes) could be used to cover them. Before that, paper born art was commonly affixed to a wall with paste or sealing wax, pasted into books, or pasted inside of the lids of boxes.

Those items which were pasted into books have generally come to us in a high state of preservation. Prints which were pasted inside box lids have in many cases been rather well preserved, since the paste seems to have sealed the wood and the box has shut out light , pollution, and extremes of temperature and humidity. Those which were adhered to the wall have in most cases been lost.

Art on paper which was framed in the Eighteenth and Nineteenth Centuries has usually suffered a fate similar to the works which were affixed to the wall. Early frames sandwiched the artwork between the glass and a wooden shingle backing, while the edges of the paper were exposed to the rabbet of the frame. Glass of this period often had a high enough sodium content to allow sodium to be leached out onto its surface where it would draw water from the air .

Moisture might also have invaded the frame from such sources as unsealed exterior walls or accidental wetting. The wood of the frame as well as the backing gave off chemical pollutants which darkened and destroyed the paper. Light coming through the glass attacked inks and paints causing them to become translucent and fade. Light also caused additives and lignin in the paper to darken and the cellulose of the paper to lighten.

This situation began to change when the British Museum developed the window mat in the mid-Nineteenth Century. Mats made from good quality cellulose could isolate the art's paper from the frame and the glass to some extent, but most backing boards were made from lesser quality fibers and could be harmful. One interesting exception among backing materials is a board which was used in France called straw board. This was alkaline and may be found today in quite good shape. Sadly, the latter part of the Nineteenth Century saw a proliferation of poor quality papers and boards which contained lignin and alum; these boards were destructive to themselves and to paper which was near them.

By the middle of the Twentieth Century, concern for the preservation of prints and drawings was high enough that cotton fiber board was brought to the market. To this has been added such preservation framing materials such as ultra-violet filtering glazing, alpha cellulose fiber board, plastics and metals for sealing and sequestering the art package, and buffering and scavenging materials. Since today's most sophisticated frame will still allow light to fall on the art object, it can not be considered the optimal preservation system. It is a world away, however, from the disasters which the previous century has seen.

The Successful Frame's Construction

The choice of any frame to house a valuable object must begin with an analysis of the load bearing potential of the moulding. Most framers will be familiar with the consequences of inadequate support, since they will have had old frames brought to them which were too thin and flimsy and have all but fallen apart.

The successful frame physically supports and protects its contents. The physical support which a frame supplies is largely a function of the rigidity of its members and the strength of its corners. Historically, frames were usually made of wood and gained strength from profile designs which had both horizontal and vertical extension. This created an "L" shape when seen in cross-section and is characteristic of both cove and reverse

mouldings which resisted bending and warping.

Many modern frames are thin and lack the strength of traditional designs. They can not be safely used without a strainer secured to the inside of their rabbet. The strainer functions to recreate the physics of the traditional "L" design.

The corners of the frame must be rigid and secure. In Italy, the corners were often attached with lap joints which gave great strength and resisted warping . French frames generally had fully mitered corners which were tied together with tapering splines; these did not resist warping as successfully as the lap joint. In the Nineteenth Century, nails replaced joinery in both architecture and frame making. Nails did not provide the degree of strength the earlier methods had and these later frames will often be seen with their corners separating.

The common practice of driving the nails into the members of the frame so that they are parallel with those members will usually result in the nails crossing each other at the miter. [FIGURE 1] This gives minimal insurance against the members of the frame twisting at the miter. If the nails are driven in across the corner, so that their length is perpendicular to the miter, they will give much greater support.[FIGURE 2] This latter method is more difficult to apply, but if the frame receives a blow the nails will not be as easily dislodged .

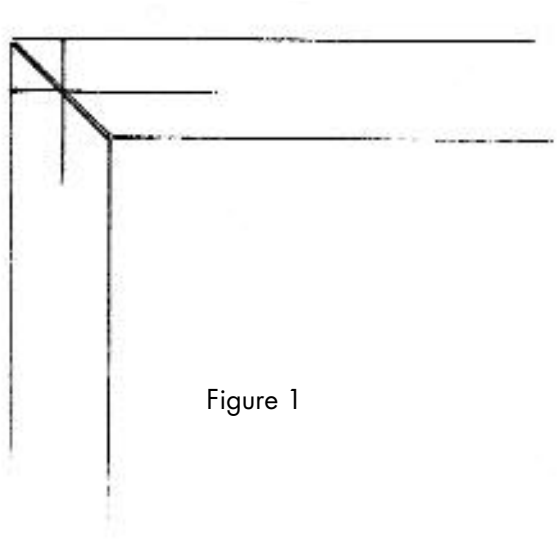


Figure 1

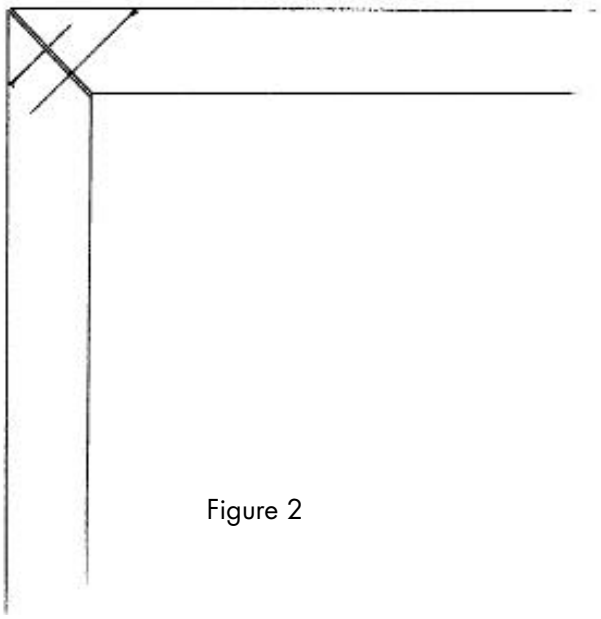


Figure 2

Contemporary wooden frames are often joined with plastic or metal inserts. These have several advantages. Inserts can be spread across the back of wider mouldings and will give support impossible for nails to achieve. Inserts also eliminate the need for wax nail hole fillers which can contaminate the work area. Different insert systems have their own advantages. Metal joiners can be applied very quickly, while some of the plastic systems allow for the use of inserts almost one inch long which join thin contemporary shapes well. Framers working which large profiles (commonly used for paintings) may prefer to use biscuit joiners which rout curved slots into the face of each miter so that a football-shaped compressed wooden insert can be glued in to bridge the miter.

If none of these technologies is available to strengthen the corners of an old frame, "L" shaped mending plates can be countersunk and screwed into the frame's back side. If these plates are simply screwed to the back surface of the frame, they will have no leverage to prevent the front of the miters from coming open. When the plates are countersunk, the bulk of wood behind their surface which is next to the frame will serve as a block to movement which would open the front of the miter. Countersinking the plates by hand is slow, but a router in the hands of a skilled woodworker can make quick work of this task. The corner which results will be very strong and stable.

The glue used to secure the corners of the frame will also help determine how well it stays together. Many wood workers prefer synthetic carpenter's type glues. These are designed to give a bond which has maximum strength and rigidity. The corners of a frame may be called on to survive twisting and repeated impacts somewhat like the wings of an airplane. Any flier knows that an air-

plane's wings are designed to flex and bend to avoid breaking. The use of a pure polyvinyl acetate glue of the archival type will produce corners which are less brittle and will resist the force of an impact with less chance of breaking. Once the glue has broken, the fasteners are all that will hold the frame together and keep the art inside from the potentially disastrous collapse of the package.

The wood screw can also be tremendously useful in joining frames, especiallylarger profiles. If a wooden frame follows traditional lines and presents a broad expanse across its back, screws can be countersunk across the miter to hold it together. The screws must be directed in from both sides so that they oppose each other. Their pilot holes must be bored far enough so that they pierce the miter; this will prevent the end of the screw from pushing one side of the miter away as it comes out of the other[FIGURE 3]. Large contemporary frames also benefit form properly set screws. Even if these frames are securely attached to their strainers, their corners can break under the weight of their glazing. Since the upper and lower sides of these frames will be above and below the line of sight of viewers, the screws can be set in these surfaces with few aesthetic consequences[FIGURE 4]. Drywall or bugle head type screws will give maximum hold with the least drilling of the wood. It both cases, it may be helpful to glue the corners together first and add the screws once the glue has dried. The screws will allow for a certain amount of tightening of the corners even after an impact.

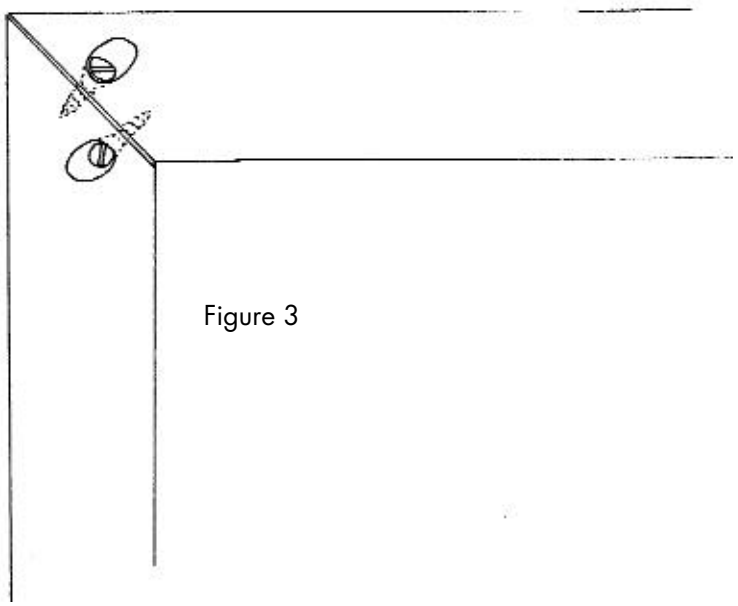


Figure 3

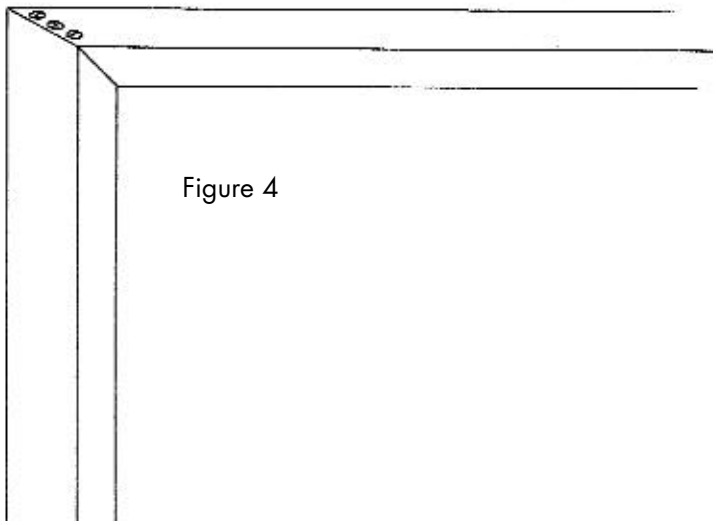


Figure 4

THE METAL FRAME

One response to the minimalizing tendency of the Modern movement in art was the metal frame. Early examples were made of brass or aluminum with their corners welded together. This gives considerable strength at the corners, but the rigidity along the length of their sides can be slight especially if their lips are thin. If the lip is less than one quarter of an inch, the frame may flex between the screws which hold it to its strainer, permitting the glazing to become dislodged. Ultimately, the welded metal frame — if it is properly secured to a strainer — can hold more weight than any other frame with commensurate proportions. This should be remembered if heavy glazing is being used or if a very large frame is needed. A welded metal core can be tucked inside a wood frame to achieve more traditional aesthetics and great carrying capacity.

The other metal frame option is the sectional frame joined with corner hardware. These frames draw their strength from their hardware channels. This back portion of the frame makes it much more rigid and resistant to twisting. However, since this feature is at the back of the frame, its ability to support heavy glazing materials is limited. Those sectional frames which have hardware channels at both the front and rear of their designs have the greatest poten-

tial support for glazing. One limitation is the fact that the expansion of the hardware in the front channel can dent the face of the frame and compromise its aesthetics. The presence of the hardware channel also fixes the amount of space the frame can offer for use both in separating the art from the glazing and in creating extra support with strainers or extra backing materials. The fact that the corners are secured with the pressure caused by the expansion of their hardware plates means that they can only be uses to carry moderate weight. The addition of a strainer can help here and this will be discussed shortly.

Other Protection Frames Offer

Frames can also provide physical protection of another sort. If a work of art with a delicate surface such as an oil painting is housed in a traditional cove frame, the extension of the frame into space in front of the painting will shelter it. This also allows for the painting to be protected in transit by covering the frame with a board. Contemporary frames lack this dimension and thus this protective potential. If a floater frame is being considered for use with a modern painting, the inclusion of extra length in the part of the frame which is perpendicular to the wall can afford similar protection.

Finally, the frame is the enclosure around the work of art which is handled . As such, it should have a durable enough finish and strong enough ornaments to allow it to stay in place and perform this function for as long as the owner deems necessary. A frail or delicate frame will be subject to frequent changing and will require the art to be handled more often. If the surface of the frame can become easily soiled and worn, it may lead to a mistaken evaluation of its contents and less careful handling. Antique frames are often designed to be enhanced by judicious aging, but few contemporary frames look better in a distressed state.

The Inner Dimensions: The Lip of the Frame

The inner dimensions of the frame are critical to its function in preservation. Three areas must be considered: the lip, the rabbet, and the allowance. The lip of a frame should be as wide as possible for the frame to best preserve the art enclosed. Antique frames had lips of all dimensions, but many have been enlarged — "rabbetted out" — to accommodate their present contents. It is common for wooden frames to have lips one quarter of an inch wide and for metal frames to have slightly smaller lips. This is virtually the minimum dimension possible if the glazing is to be sealed to the backing board, since at least one eighth of an inch of tape is needed on the front of the glazing to ensure the seal. A slightly wider lip will provide much greater latitude for the use of spacers and sealing options needed to support the art.

Another problem which calls for wider than ordinary lips and greater than normal allowances in frames are the works which Contemporary artists have begun creating on four and eight ply conservation quality board. These boards may be too heavy for most archival hinging and the artist may prefer that the frame overlap the edge of the board. If this is to be done, a more generously wide spacer permits the use of an extra wide allowance so that the board can expand if the relative humidity rises, and will also allow for slight variations in the dimensions of the art to be covered without any crowding .

The allowance used around a mat package or a back mat with the art floated on it should be no less than one eighth of an inch. Tolerances tighter than this will not allow the mat board to expand in rising relative humidity and can lead to warping.[Editor's note: according to Jared Bark's 1993 Preservation/ Conservation supplement, "With a 10% change in RH, a typical machine made paper will swell or contract against the grain .3% and with the

grain .05%.] This problem is especially acute in metal frames, which will not respond to changes in humidity but which can in fact shrink as the temperature drops. Sadly, metal frames are often made to the tightest tolerances so that the glazing will not rattle around in them. It is safer to cut the glazing so that it is slightly larger than the mat package and will fit more snugly in the frame, keeping the mat package sized as usual to maintain the necessary allowance. As the size of the frame grows, the allowance should also grow since the board will be expanding at a given rate per unit of length. Likewise, larger frames should have larger lips since they have more length to flex and will be carrying more weight.

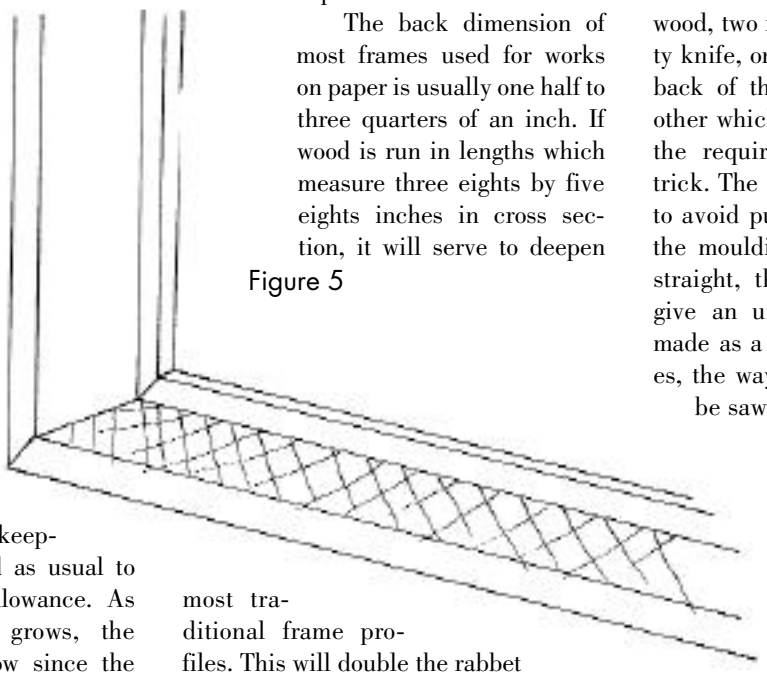


Figure 5

THE INNER DIMENSIONS: THE RABBET

The inside surface of the frame perpendicular to the lip, the rabbet, is one of the most important parts of the frame from the viewpoint of preservation. Unfortunately, contemporary copies of traditional frames usually maintain all the proportions of the original. Thus we may find a Twentieth Century copy of an Eighteenth Century frame has a two hundred year old rabbet dimension. Framing has come far enough in the latter part of this century to tell us that a deeper rabbet will accommodate deeper mats, sinks, spacers; in short everything which helps preserve the art being framed. The scarcity of antique profiles which have any significant rabbet depth has led many framers to innovate in the area of adding backing materials to extend the depth of the frame.

The back dimension of most frames used for works on paper is usually one half to three quarters of an inch. If wood is run in lengths which measure three eights by five eights inches in cross section, it will serve to deepen most traditional frame profiles. This will double the rabbet depth of the frame and will fit in the back of most one inch wide profiles. These strips can be cut to the dimensions of the rabbet and if the frame is not an antique, they can be glued and nailed or screwed with countersunk screws to the back of the frame. If the frame is antique, the screws can be used without any glue so that the only alteration to the frame will be the screw holes.

If the deepening strips are too visible from the side, they can be beveled at the back to make them less evident. The strips can be stained to match wooden frames and then waxed for a more finished look. If the frame is gilded in the traditional manner, its sides will have been painted with a dull shade of casein paint. Since this paint is difficult to obtain, a substitute can be made from colored acrylic gesso, matte acrylic paint, or from ordinary acrylic paint which has been made matte with the addition of ceramic silica or rotten stone.

Another alteration which may be needed is the expansion of the rabbet size of the frame. In frames made of soft wood, two intersecting cuts with a utility knife, one which is in plane with the back of the lip of the frame and the other which is parallel to the rabbet at the required dimension, will do the trick. The cuts must be made with care to avoid puncturing the lip or splitting the moulding. Where the grain is not straight, the knife may follow it and give an unstraight cut. If the cut is made as a combination of lighter passes, the wayward parts of the grain can be sawed through.

Where the wood is harder or the rabbet is deeper, another strategy will help. Cuts can be made in the rabbet in two parallel series, each of which is diagonal to the length of the moulding in opposite directions [FIGURE 5]. When these cuts have been completed, they will form a field of diamond shapes on the rabbet. A sharp wood chisel can be used to shavethese diamond shaped bits of wood off of the rabbet. If the chisel is properly sharpened, no hammering will be required, only a steady side to side rocking motion as the front of the chisel moves through the wood. When these bits have been removed, the surface can be smoothed with a bull nose plane and the corners, where the plane can not reach, can be dressed with a utility knife.

CONSTRUCTION MATERIALS FOR FRAMES

The materials of which a frame is made can have an impact on the object which it holds. Woods, glues, metals, oils, and various calcium compounds comprise most frames made before this century.

The hazards which wood poses to paper are widely appreciated in the framing community. The peroxides and acids which issue from wood, especially

where the grain has been cut through, will discolor and eventually degrade paper which is adjacent to it . From a preservation standpoint, the gilding is on the "wrong part" of the frame, since unbroken metal foils are one sure barrier to polluting gases and a gilded rabbet would have be a great protection.

Tapes and metal/plastic laminate films which contain aluminum foils can be used to seal the rabbet of frames and the back sides of wooden fillets. If an historic frame is having its rabbet sealed, the use of a nylon, aluminum, polyethylene film will serve best since it can be ironed onto the wood with its nylon side out and can later be pulled away without harm to the frame itself. The aluminum itself should not come in contact with the paper since it will oxidize and discolor the paper.

This chance of oxidation is also true of welded brass and aluminum frames, but those which have been anodized seem to be more inert, given their lack of any surface oxidation. The oxidation of aluminum is more subtle than that of iron. Aluminum oxide is dull gray and less dramatic than rust, but it is still a chemical and physical pollutant which must be sequestered from the art.

Framing Unvarnished Paintings

The framing of paintings is in many ways simpler than the framing of paper born art work. Most paintings in oil or acrylic will not need any glazing and can be set in a frame in a relatively straight forward manner. If a painting contains passages of unpainted surface where canvas or board is exposed, then it should probably be glazed to protect those areas from dust.

If the paint covers the entire surface of the canvas, the painting may be maintained by careful dusting with a sable brush. This can be much more safely done if the painting has been varnished by the artist or a conservator. The application of varnish is a very delicate operation which can be best handled by a conservator. If it has been done by the artist, any flaws in the result can be regarded as part of the artist's effort. A framer may do a good job of varnishing a painting and still be criticized because the result does not meet the expectations of the owner or the artist. This may lead to a request that a conservator be brought in to remove the varnish and redo the job at considerable expense to the framer.

If the painting has no varnish and the owner does not want to pay for a conservator to varnish it, the framer can install it in a frame having warned the owner that it should be hung and stored in areas where its fragile surface will not be in danger. The important considerations are the isolation of both the surface and side of the painting from the lip and rabbet of the frame. The sides of the paintings can be protected by lining the rabbet with a paper or plastic faced aluminum film, as was previously mentioned. The lip is somewhat more complicated.

The surface of an oil painting takes many years to dry fully. Acrylic paints also change subtly with time, and isolating them from oxygen (as a metal foil would do) may have unanticipated consequences. Simple strips of conservation quality board should therefore be glued onto the back side of the lip of the frame. If any of the fibers form the board stick to the surface of the painting, they can be removed by a conservator. The board will be soft enough to protect the paint surface from abrasion and can be sculpted with a knife to give room for any impasto which runs under the lip of the frame.

Another material which is used for lining the lips of painting frames is polyethylene foam. This has no additives, but has been stabilized by the cross linking of its molecular structure. This is softer than conservation quality board, but it must be attached with pressure-sensitive double-sided tape. This means that it will not remain in place as well as the board which has been glued in with a polyvinyl acetate glue.

Any gaps around the painting can be filled with conservation quality board and the painting can be secured it the frame with brass mending plates. The best plates to use have more than two holes so that two screws can be set in the back of the frame and none needs to be driven into the stretcher. If a contemporary frame is used which does not have a large back area to screw into, the painting can be secured with brads if it fits inside the rabbet depth of the frame. The brads should be pushed in with a brad pusher and not hammered in; they will be strongest if they are pushed in parallel to the surface of the stretcher, but at an angle to the surface of the rabbet.

Strips of conservation quality board should be set on the back of the stretcher before the brads are pushed in to isolate the stretcher from the brads if a backing board is not used. If a backing board is used, the brads or mending plates can press gently on it to hold the painting in place.

The backing board has several advantages. It keeps pollution away from the exposed canvas, it gives some protection against punctures from the rear, and it stops the painting from vibrating while it is being transported. The air between the board and the back of the painting will serve as a damping element and will take out most vibration even if a hole has been cut in the board.

Glazing for Works of Art on Paper

The framing of works of art on paper is much more complicated. The need for glazing in front of the art is one of the first complications. The excellent analysis which was done of the problems and possibilities of glazing works of art by Jared Bark in the first PFM Conservation

Supplement has been reproduced here. Some further remarks about glazing may be helpful.

The smooth surface on glass and acrylic sheet make them useful for preservation because they do not scatter light. Therefore, they can be spaced away from the art work without loss of clarity. These same smooth surfaces can present problems if the surface of the art is pressed against them. As the medium in which the art was executed deforms to fit the surface of the glazing, it can form a tight physical bond. If the art is done in acrylic paint and the glazing is cast or extruded acrylic, the problem is compounded because acrylic adheres to acrylic and the solvent for one will dissolve the other. This is a fact which should never be overlooked when contemporary art is being framed. An oil paint or an oil-based ink can also adhere to glass or acrylic, especially if the oil is not utterly dry. The emulsion on photographs is commonly found stuck to glazing if the frame did not provide adequate separation from the glazing and the humidity was elevated.

High levels of relative humidity can cause condensation on the inside of the glazing if the temperature changes rapidly. Frames which are placed on damp walls and which admit moisture to enter from the rear can suffer this problem. Similarly, a frame moved from a cool, air-conditioned space to an hot, damp one can also suffer.

Other attributes of glazing materials may cause additional problems. When glass breaks, it forms an incredibly sharp edge. Glass cutting involves breaking the sheet after the glass has been scored. It is essential to soften the edges of cut glass with a sharpening stone or an edge seamer to protect both the framer and the art. Undulled glass can cause tiny cuts on the hands of those manipulating it. This may hardly be felt initially, but can lead to bleeding on the art.

The strength of glass is a function of

its thickness. Very thin glass is not sufficiently break resistant to be used in preservation framing. Single strength or window glass can be used for smaller frames, but larger frames need double strength or thicker glass. If a large pastel is being framed, this thicker glass may seem too green to be used, but there are low iron or water white glasses which can be found. These glasses are all but colorless, but may be quite expensive. Laminating together two thinner sheets (or lites) of glass with a plastic film can produce a shatter resistant sheet which will stay together even when broken. An ultraviolet absorber in the laminate makes this product especially useful for preservation.

Cutting these laminated sheets requires some practice. The glass must be scored on both sides so that the scores line up. This can be most easily be done on a wall-mounted cutter. The cracking open or "running" of each score can be effected by tapping on each cut along the score with a slotted screw driver. The tapping will cause the score on the opposite side of the sheet to run. When both sides have been completely run, the sheet should be gently flexed so that the laminate begins to stretch. Use caution, since over flexing can cause shell shaped flaking along the edges of the scores. Once there is some movement, a double edged razor blade can be carefully worked into the gap and used to cut the laminate.

Any glass cutting can produce tiny shards of glass as the wheel gouges the surface. These shards can land on the surface of the glass so that the flat side of the shard is stuck to the glass. Their removal can be difficult. If they can not be easily brushed off, it may be possible to float them off with alcohol. Alcohol does not have as much surface tension as water and can flow in under the shard more easily. The removal of these glass bits must be approached with extra caution when working with coated reduced-reflection or ultraviolet filtering glasses, since their surface coatings may be disturbed.

Alcohol and water work well to

clean glazing materials. If there are sticky materials on the surface, a concentrated, ninety percent, isopropyl alcohol can remove them. This can be found in some drugstores. A final wash with water will produce a clean and dust-free surface if a well washed and thoroughly wrung out chamois is used. Though the chamois is expensive, it will last for months or years before it begins to shed and must be abandoned. The alcohol can be applied on a soft paper wipe, sparing the chamois the effects of alcohol wetting.

The only material which will require another cleaning solution is oil. Some glass cutting is done with an oiled wheel, and the oil which this leaves on the edge of the glass can spread. An ordinary dish detergent can be used on a wipe to clean this off. Commercial cleaners may contain colorants or unknown components and may leave this material on the surface. The final water wash is all that is needed to control static and as in any preservation procedure, the simplest approach which has the fewest unknowns is preferred.

The delicacy of the surface of acrylic requires special consideration. A couple of tools will prove very useful in handling it. The first is a piece of heavy, solid cardboard or light masonite which has had synthetic velvet stretched across one side and glued to the edges of the other side. This board should be designed so that it will fit the framing table and can be used during the glazing and fitting of the frame and can be stored elsewhere during matting and hinging. The velvet should be as dark in color as possible to aid in the cleaning since any dust or smears will show up when the glazing is suspended over it. The other useful tool is a soft bristled Oriental brush. These can be purchased from art supply houses in widths up to four inches. Two such brushes can be fitted end to end in a handle to make a brush which will have the shape of the ordinary drafting brush. If a ordinary drafting brush is used on acrylic it will make tiny lines in the surface of the sheet.

The production paper found on the acrylic can be most easily removed by rolling it off like the lid of a sardine can. Any slight surface abrasions on the acrylic sheet can be polished out with a white vinyl eraser. Deeper scuffs will require a plastic polish, while true scratches, those which can be felt when a fingernail is run across them, will doom the sheet. Any such scratch may be polished out with sufficient industry, but the process will produce a depression in the surface of the sheet which will create a lens when light is shined through it and will show up on the art or the mat.

If a sheet of acrylic is being used with a large modern frame, and the acrylic is slightly too large, it can be sized to fit the frame by filing its corners down. The frame will flex to fit the sheet at the center of its sides, and the extra space which is created will give more clearance to the art package. There are obvious limits to this idea, since the backing board may be exposed if the centers are pushed out too much. Acrylic sheet can also absorb moisture and can actually become warped if it is exposed to damp conditions on one side. Thus, if the sheet is wedged into the frame too tightly and is exposed to high humidity, it may become dangerously distorted.

When glass is fitted into a frame, care must be taken to ensure that it is not too tight. Since wooden frames will expand in rising humidity, they may squeeze in on the glass and crack it. Any irregularities in the rabbet can also cause cracking, especially if they are on the bottom. In that case, the glass will be resting on the bump and any impact will be transmitted to a tiny area of the bottom of the glass. The corners of a sheet of glass are especially fragile and were often cracked by the corner hardware used in older types of sectional frames.

The range of glazing products available today allows the framer to filter ultraviolet with glass or acrylic, reduce

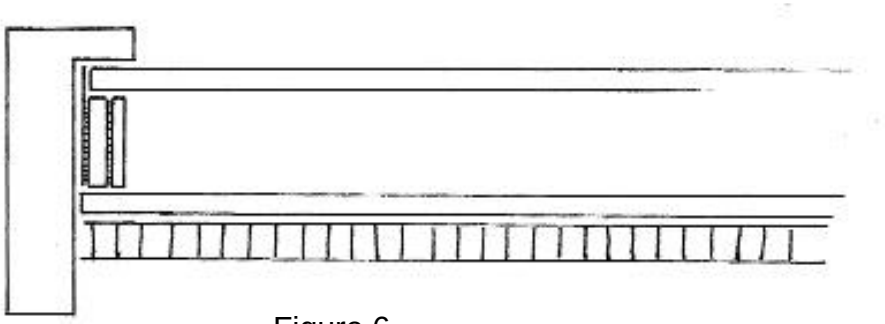


Figure 6

static with glass, resist breakage with acrylic or laminated glass, reduce reflection with coated glass, avoid color with acrylic or low iron glass and to do all of the above with coated, low iron, laminated glass. As the products perform more functions, their cost will increase, but cost — not availability — can now be the determining factor.

SPACERS

Between the glazing and the art work there must be a mat package or a spacer. Matting is far too complex to be covered in an overview of framing, but some of the ideas presented in last year's Preservation Supplement about spacing are worth reviewing.

The most common materials used for making spacers are wood, plastic, and conservation quality board. Wood may provide a needed element in a design strategy, but when used as a spacer it will show and can not be covered with a metal foil unless it is gilded. Uncovered, it can be expected to contaminate the package to some degree. Painting a clear sealer on it may slow this process but it can not eliminate it altogether. Wood is also easiest to work with when it is bonded to the frame, but this spacing strategy has drawbacks when it comes time to fit the package.

Plastic spacers can be made of highly inert materials such as polyesters and can provide some separation between the interior of the package and the wood of the frame. If the exposed plastic surface does not meet the aesthetic requirements of the frame designer, its surface can be sanded and conservation quality board can be adhered using polyvinyl acetate glue, or a spacer can be fabricated of conservation quality board and polyester film.

To make this latter spacer, four ply board can be adhered to archival corrugated board with polyvinyl acetate glue. This laminate can be cut into strips of the desired width on a wall mounted cutter. The corrugations of the back portion should be perpendicular to the length of the strip. Polyester sheet can be sanded and cut into strips one eighth of an inch wider than the laminate strips and glued with polyvinyl acetate to the corrugated side. The exposed portion of the polyester can be lapped over the edge of the glazing to ensure that the spacer will not slip once it is in the frame[FIGURE 6]. This spacer can be secured to the edge of the glazing with double-sided acrylic tape after the glazing has been given a preliminary cleaning. This simple spacer will keep the glazing away from the art and will allow for packaging options to be discussed shortly. More subtle designs are discussed in the last PFM Supplement which dealt with spacing.

The Backing Board

Moving backward through the frame, the backing board is encountered next. Tremendous progress has been made since wooden shingle was used behind the art in the previous century. The corrugated and other ground wood boards which immediately followed the wooden backing boards were often nearly as destructive. Yet today there are a number of boards either made from or incorporating synthetic materials which make stable puncture resistant backings and which provide some protection from atmospheric pollution.

Some boards combine a polystyrene foam center with facings of different paper products or plastic sheet. These boards draw their strength from the material which forms their surfaces and if paper is used, the board can warp if one side becomes damp. Questions remain about the ultimate stability of polystyrene, but little anecdotal evidence has been produced to demonstrate any harm which it has caused in such boards.

A far more rigid board has been made by using thicker foam centers and impregnating the facing papers with a synthetic resin. These boards are costly but represent one of the greatest strength to weight possibilities available, and, in addition, they will resist warping. Less expensive plastic boards are manufactured from polyethylene which has been corrugated or from polypropylene which is formed into a fluted design. These boards are offered by conservation supply houses and can be found in commercial grades which may contain ultraviolet inhibitors and antioxidants for roughly the same price as the polystyrene foam cored boards. Additive-free grades of the polypropylene board will be more expensive — equivalent perhaps, to the polystyrene types which are faced with superior paper products.

The polyethylene and polypropylene boards will resist warping from moisture but can be warped if heated. One significant advantage to such boards comes from the fact that they can be welded together, edge to edge, with hot

melt glue to form a larger backing board without lamination for the framing of oversize works of art. This bond is much stronger than that which tapes would provide and will not be as unstable as pressure-sensitive tapes would be.

The plastic portion of these boards should provide some isolation of the frame package from atmospheric pollution. These same boards can be made with particulate metals (such as copper) included in the plastic. Copper, like silver, is a metal which oxidizes readily and pollutants which can penetrate the plastic will react with the copper, which serves as a sacrificial scavenger. When the copper has reacted and is exhausted, the board changes from copper colored to black, indicating the need to change it.

Other barriers to pollution can be found in boards and papers which contain molecular sieves These are silicate particles which have pores of a known size which trap and will not release pollutant molecules. Others may contain active carbon which can adsorb or more weakly bond with such gasses due to the fact that the carbon and the gas have weak electrical charges which are opposite and attractive.

One material which seems less promising as a pollution barrier is corrugated board made from lignin-free paper which has had calcium carbonate added. Since paper is highly transparent to gases, and this board as minimal glue layers in it, the only thing which might combat the pollution is the calcium carbonate. Since that is present in the form of a solid and the pollution is gaseous, there is little likelihood of their interacting in the absence of significant amounts of water. This archival corrugated board can still be quite useful in creating structures inside the frame package and may serve quite well in environments in which the air has had the polluting gases filtered out, but its potential as an isolating backing board does not measure up to some of the others.

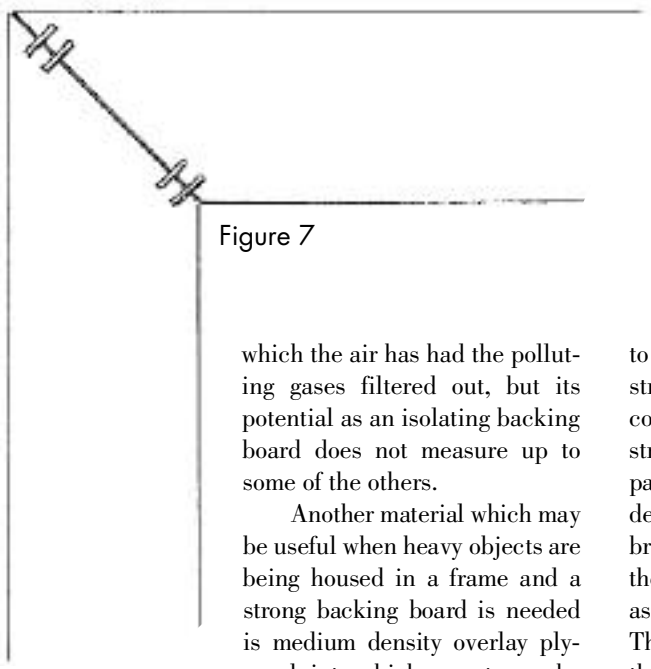


Figure 7

Another material which may be useful when heavy objects are being housed in a frame and a strong backing board is needed is medium density overlay plywood, into which mounts can be screwed. This product is made for the construction of poured concrete buildings. The plywood is faced with a smooth coating of a phenolic resin. This resin seals the wood and makes a surface which is quite easy to paint. The edges of this board can be sealed with aluminum tape or by ironing plastic/aluminum to its edges, thus limiting the harmful potential of the wood in the core.

Regardless of the material which comprises it, the backing board should not be attached to the strainer in all but the most unusual cases, since the wood of the strainer will respond to changes in climate differently than the backing board and warpage can be expected.

STRAINERS

The last major component in the frame is the reenforcement structure often found behind it, the strainer. This is a wooden framework which nests inside and is screwed to the frame. The strength of the strainer is more a function of the width than the depth of the wood from which it is made.

A strainer which is only one half of an inch thick (deep), but is two to three inches wide, will function very well. The lack of depth in the wood will allow this strainer to fit into many frames even when most of the space in the frame has been used to space the glazing away from the art. The extra width will allow this type of strainer to excel in performing the functions a strainer is truly needed for: stiffening the corners and sides of the frame. The strainer performs a function here which parallels the joinery and structural design of the traditional frame. The broad, properly joined strainer will keep the corner of the frame from twisting just as the lap joints of earlier frames did. The width of the strainer will reenforce the frame in a direction perpendicular to its depth, just as the cove design did. To fulfill these roles, the strainer should be as rigidly joined as possible.

The most effective way to achieve this strength is a combination of gluing and stapling. Nails, even if set perpendicular to the miter, will not give maximum resistance to twisting along the miter. Since the strainer will be required to limit the corner to corner flexing of the frame, it can not be allowed to twist at its corners. The staples will combat this problem best if they are concentrated and the inside and outside corners of the miter.[FIGURE 7] Any staples placed at the center of the miter will not stop the sides of the strainer from twisting. The

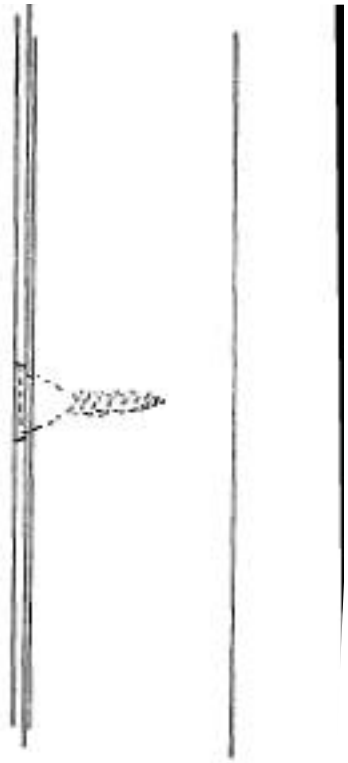


Figure 8

staples must be aligned on opposite sides of the joint to perform properly.

Cross and corner braces can further enhance the performance of the strainer. Corner braces need not be very long to add to the rigidity of the corners and can be cut from the scrap left from cutting the strainer itself. Cross braces are needed when the size of the frame grows and even the stiffening effect of the width of the strainer may be challenged by the length of the sides of the frame. These should be glued and stapled in the same manner as the rest of the strainer. The strainer must be screwed to the frame to complete its installation. Nailing the two together will deliver blows to the frame which will be unacceptable for the art inside.

The two commonly used techniques for screwing the strainer to the frame involve countersinking the screws through the side of the frame into the side of the strainer [FIGURE 8], or countersinking the screws in the back of the strainer so that they angle forward and out into the inside of the frame [FIGURE 9]. Setting the screws in the side of the frame raises aesthetic and physical problems. If the frame is made of wood which has been given a clear finish, brass screws are usually employed. Silver metal frames are usually attached with stainless steel or other silver colored screws, while painted frames are usually secured with screws which have been painted to match the frame.

Screws placed in the sides of the frame can only enter the strainer if it is set in a part of the frame which is adjacent to them. If the frame is refurbished to provide more spacing between the glazing and the art, the strainer may be too far back to accept the screws. Putting the screws in from the sides leads to a further problem if the frame is large, since such frames should not be laid on their backs or turned on their sides, and putting in or taking out the screws on the bottom of the frame will involve placing it on blocks off the floor and working under it as an auto mechanic might.

If the screws are angled toward the frame from the back of the strainer, any color screws can be used since they will not be seen. The creation of the holes in the back of the strainer can pose some difficulties. It is easiest to hold a drill with a good countersinking bit in it so that the drill is initially perpendicular to the surface of the strainer and the point of the bit is at a spot which will become the opening of the hole. Once the hole has been started, the drill can be angled and the boring can proceed to a point at which the head of the screw will be beneath the surface of the wood. The bit shouldcome through the side of the

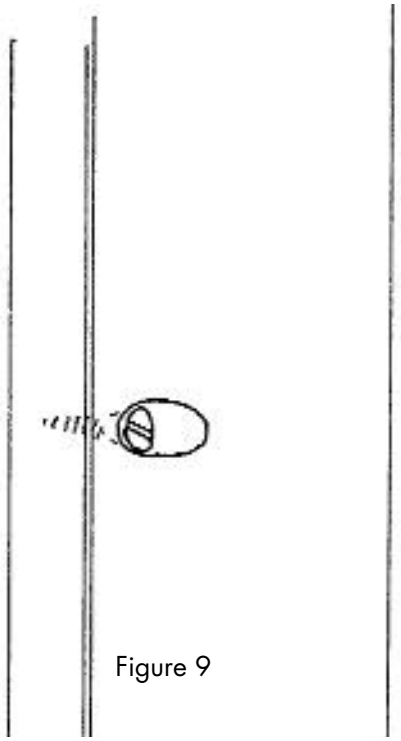


Figure 9

strainer but care must be exercised to avoid overdrilling.

The strainer should have the same outside dimensions as the mat package. This means that the strainer will be smaller than the frame by the customary allowance. This will result in some loss of support in the corners, but it will allow the strainer to pull the sides of the frame in to fit the glazing/matting/backing board package. This clearance is especially important when using metal frames, since the wood may expand as it ages and the frame can not.

If a strainer is found to be too tight when it is removed from an old frame, it can be planed or cut down at the corners only and refitted. The centers of the sides of the frame will flex out to accommodate the size to the strainer, and unless the spacer or glazing is in peril of becoming dislodged, this extra space will permit greater expansion of the matting materials inside of the frame.

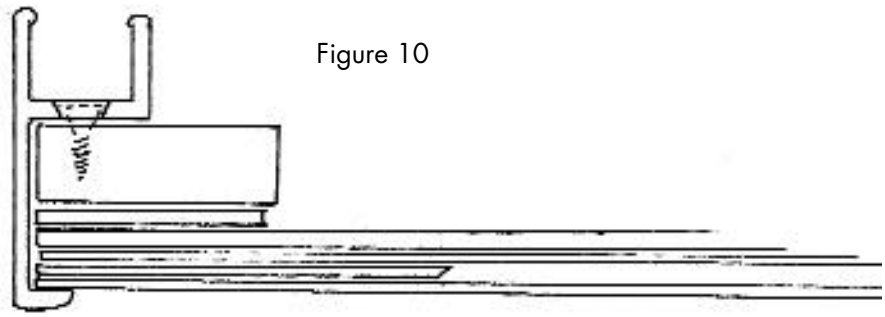


Figure 10

Strainers can be used to reenforce those sectional frames which have deeper profiles. Their aluminum sides can be drilled and screws found to match their coloration. It is easier to attach the strainer to the hardware channel in the back of the frame and this can give a full measure of support if the strainer is pushed back so that it is flush with the inside of the channel [FIGURE 10] . The space between the strainer and the backing board can be filled with scraps of mat board which have been glued on the surface of the strainer.

THE FITTING PROCESS

With the major components of the frame in mind, the process of installing the art in the frame — the fitting procedure — can be addressed. The steps involved here will be largely the same regardless of the type of sealing and hanging techniques which are employed.

Fitting a work of art into a frame is a delicate task. Like all other handling of valuable art and artifacts, it should only be undertaken be trained and experienced staff. The framing of large and oversized art work is especially hazardous. Each maneuver must be monitored by those carrying it out, with fluent communication encouraged to alert all involved of impending dangers. At each step of the way, someone needs to assume the role of leader and explain to those involved how the step will be carried out and listen for thoughtful suggestions from the team members. Even if the art work is small enough so one person can handle it, the addition of a "spotter" to watch for problems is important in the technique which is to be outlined here for large works.

Mat packages less than twenty four by thirty inches (approximately) can be considered medium size and can be fitted flat on the table. They are best turned over for final closure by two sets of hands, however. Packages larger than that are best fitted on a sturdy artist's easel. The very largest frames will have to be assembled resting against the wall with their bottom sides raised off a clean floor and resting on slip-proof blocks. The tools needed for the fitting will comprise a velvet covered board, soft haired brush, damp chamois, alcohol and wipes, interleaving tissue, the means used to secure the package in the frame such as brads or framing points, and a pushing or squeezing driver or the strainer to be screwed in.

Once the artwork to be fitted has been secured in a window mat, it should have a piece of interleaving tissue inserted between the back of the window and the face of the art. Once the glazing material has been cleaned, the mat and backing board can be rested on the velvet, face up, and the glazing sheet rested on edge at one side. It is safest to align the mat and glazing so that they touch along one of the longer edges and that edge is perpendicular to the edge of the work table [FIGURE 11]. The cleaned glazing and the mat package, with the tissue left in, can now be brushed with the soft brush to remove any remaining dust. The glazing can then be gently lowered on to the face of the mat and the window mat and glazing lifted together so that the interleaving tissue can be

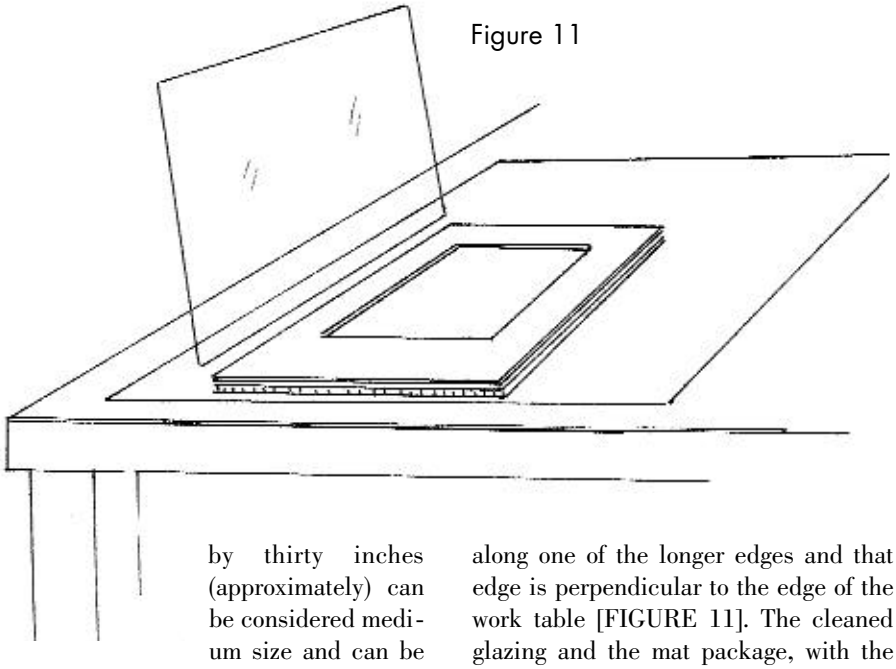


Figure 11

lifted out without being dragged across the surface of the art.

Certainly the most tedious part of fitting is checking for dust. If dust is discovered on the surface of the window mat, the glazing can be gently lifted and a strip of blotter card can be inserted to draw the dust mote out to the edge. If dust is spotted on the surface of the art away from the spine of the mat, the glazing and mat can be lifted together and a small (00 to 0000 size) sable brush used to gently lift the dust from the surface of the art. If the dust is on the side of the art near the spine of the mat, the glazing will have to be lifted alone with care being taken to prevent any finger marks being deposited on its inside surface.

Some works, such as dark photographs, are very hard to fit. These can be fitted without the interleaving tissue to eliminate one more possible source of dust. They can be stood up in their mats and closely examined for dust in a near vertical position. The tiny sable brush can be used to lift dust off the surface while the photo is standing so that dust which is removed will not settle onto another part of the surface. Pastel and loose chalk and graphite drawings must be treated like photographs and fitted without interleaving tissue. The surface of these media is obviously even more fragile than that of a photograph, so here too, any brushing of their surfaces is prohibited. Dust must only be lifted of with the small brush.

The use of compressed air to remove dust from a frame package is fraught with so many potential dangers that it must be avoided. Even if the air stream is watched by the person using it, the turbulence it creates in the environment can have unpredictable results.

If pastel is being fitted, it can be given a primary fitting and left standing for a day or more in a rack so that anything loose can fall onto the bottom spacer or the bottom of the mat bevel for later removal with a brush. This may slow down delivery time, but the owners of such delicate works will probably prefer to wait if they can be assured of such careful treatment of their work.

Once a dust-free condition has been achieved, the frame can be set around the glazing/mat/backing board package and lifted and turned so that it can be secured. If the medium being framed is a friable one such as pastel, it is unwise to turn it face down and the mat and art package should be secured into its frame in an upright position on an easel. If the frame being used is backloading with side screws, such as a welded metal frame, the fitted mat package can be set on top of the strainer and the frame fitted over the top so the screws can be inserted while the frame lies face up. If a sectional frame is being fitted, the safest method of assembly begins with placing the mat package on top of a stack of board or shallow box so that it rests an inch or so above the surface of the work table. The sections of the frame can then be fitted together around the mat and glazing package and the screws tightened from underneath as each corner of the frame is rotated off the edge of the table in turn.

It is safer to move to near vertical fitting when the matted art work exceeds

the approximate twenty four by thirty inch range. Setting a sheet of glass or acrylic next to such a large mat and lowering the glazing down on to its surface is inherently risky. Furthermore, gravity will cause the glazing to sag onto the surface of the art while it is lying on its back. This may result in some disturbance of the surface of the art.

Instead, the backing board and mat package can be stood up on the easel so that they face the fitter. The clean glazing is then carried to the easel and set in front to the window. Any dust removal can be effected while the package is on the easel by lifting the glazing forward and using the brush or blotter to lift out the dust. If the dust is on the lower part of the art or on the bottom of the face of the window mat, the glazing will have to be lifted clear of the easel to remove it. Once this package is free from dust, the frame should be brought over and the clean package can be lifted up and into it so that the filled frame can be safely rotated to face into the easel so it can be secured. This method permits the greatest latitude for spotting and removing dust, but the need to lift the mat/glazing package into the frame makes this harder to use as the package grows larger.

An alternative approach begins with placing the frame on the easel so that its rabbet and lip are exposed and setting the cleaned glazing in it. Both the glazing and the mat package should be thoroughly examined for dust before the mat is stood in the frame behind the glazing. The backing board can then be inserted and the frame lifted and rotated so that it faces out on the easel and a final check for dust is made. If the frame parts do not fit easily and snugly, brads or framer's points should be driven into the center of each side before the frame is turned to prevent the package from slipping. The procedures for fitting a frame with a spacer will differ from those used when a mat is present.

The spacer can be attached to the glazing, the frame, or the back mat. The last of these techniques is the most seldom used but can offer some advantages. If the art might be removed from the frame and stored outside it, having the spacer on the back mat will make the mat into a tray which will be more rigid and easier to handle and will also be easy to protect with a covering board. The important thing to remember is that the only safe way to secure the spacer to the back mat is with a strip of linen tape which is applied to the back of the back mat and which extends around the side and up onto the outside of the spacer[FIGURE 12]. When this has been done on all four sides, the corners can be secured with more pieces of linen tape. This method permits the sides to be folded down so that the edges can be examined and the hinges easily reached if it becomes necessary to remove the art from the back mat. This type of package can be fitted face up on the table if it is small, with the clean glazing laid on the edges of the spacer and the frame fitted over all once it is free of dust. If a strainer is used, this should be set under the mat and backing board before the fitting begins.

Figure 12

If this sort of spacer is used with a larger frame, it can be fitted face out on an easel or set into the glazed frame just as the mat package can. This type of package can be taped together after fitting and kept upright in advance of the arrival of the frame, if the appropriate taping strategy is used. This will be described shortly.

The adhesion of the spacer to the rabbet of the frame entails a number of problems. If, during handling, the edge of the frame is pulled away from the rest of the package, this spacer will come with it and the edge of the glazing can be dislodged. A more persistent problem is the difficulty of fitting a frame with this type of spacer. Here, the only option for fitting the frame is the insertion of the mat or back mat package into the frame. If there is any dust present, the art will have to be lifted out and the suction created as the mat package leaves the cavity of the frame will draw dust into the frame.

The attachment of the spacer to the frame also presents problems. If a wood or paper based spacer is used, it can be secured to a wooden frame with a polyvinyl acetate glue. A paper based spacer can be attached to a metal frame with double-sided acrylic pressure-sensitive tape, but this bond may fail when oxidation weakens the tape. Wooden spacers should not be attached to any frame with pressure-sensitive tape since this material does not bond well to wood in the long run. Plastic spacers can be bonded with pressure-sensitive adhesive to metal frames, but they will adhere much better to the glazing and will be much easier to fit in that condition. They, too, should not be bonded to wood with a pressure-sensitive adhesive.

The placement of the spacer on the glazing has several advantages. It facilitates fitting since the glazing can be brought to the mat package or vice versa and there is minimal suction if the two are separated for dust removal. This type of spacer will not dislodge if the edge of the frame is pulled away, and if glass is

used and it is fractured at the edge, the spacer will provide some stabilization of the shards. In this case, as in the case of the spacer attached to the frame, the glazing should first be cleaned. The mat board and sanded polyester film spacer can then be attached with double-sided acrylic tape in a pinwheel pattern and the excess trimmed off. The spacer can be reenforced with a strip of tape which is attached to the portion of the front of the glazing which will be hidden by the frame and which is wrapped around to the side of the spacer. This taping should be especially strong at the corners to hold them together. The polyester layer in the spacer should keep the volatile portions of this tape away from the inside of the frame and should extend the life of its bond.

Frame Sealing

The mention of tape in connection with a mat package brings to mind the question of whether and how the package should be sealed. There are a number of factors which must be considered in this context. What is being sealed in and what is being sealed out? How long can the seal be expected to last? How effective will the seal be under different conditions? How difficult and expensive will it be to establish various levels of sealing of the package? How much benefit can be expected from a sealed package?

The materials which are to be sealed in a package with a work of art on paper should be as well known and, therefore, as simple as possible. The fewer the variables that are included, the fewer chances there are for an unanticipated problem. If the components have been proven over long periods of time to have no adverse effect on delicate art which has been stored in proximity to them, they should work well in the future. Boards and hinging materials made of pure cellulose will be chemically similar to the paper on which the art has been done, as will vegetable starch hinging paste which, like paper, is a polysaccharide. Synthetic glues have a less proven track record than animal and vegetable glues and pastes, but the best of the synthetics certainly seem to be stable and relatively inert.

The inclusion of plasticizers and tackifiers in pressure-sensitive adhesives raises more questions. These additives are often not chemically linked to the material which they are modifying . A plasticizer, for instance, can keep a material supple by holding its molecular structure apart so linkages which would create more rigidity can not form. This sort of material may migrate out of the substance to which it was added. This could be especially troublesome if it migrated out into a closed environment.

One question to ask in designing a package which will house something valuable and especially a package which is to be sealed, is: do any of the materials to be used have an odor? The human nose may not be as acute as that of other mammals, but it can detect a vast array of off-gassing molecules. Some things like hinging paste may have a benign odor, but a tape which smells of vinegar is probably emitting acetic acid. If the materials to be used inside the package have been determined to be stable and inert, the next question involves the nature of the seal and what it will exclude.

Different materials can be used to seal out particulate and gaseous pollution, humidity, and light. Nothing can give long term insulation from changes in temperature, so the effect of these changes on the materials and on the design of the package must be considered. No package containing any materials which are conditioned to higher than accepted relative humidity conditions can be safely sealed. Indeed, since packages which contain glazing will transmit water vapor through their glazing, having the materials to be sealed slightly on the dry side will permit a greater margin for safety. The accepted conditions referred to here are fifty percent relative humidity at seventy degrees fahrenheit or roughly twenty degrees celsius.

Most art on paper will do well in somewhat dryer conditions than these, but extreme drying will cause the paper to become brittle and will cause paint films and emulsions to crack. If a package with damp components is sealed, the relative humidity can rise as it cools and cross the threshold at which fungal growth can occur (namely, sixty five to seventy percent). A damp package may also experience condensation if it is suddenly illuminated strongly and the paper products and air within warm up more rapidly than the glazing.

Excess humidity must never be sealed in. The only true barrier to humidity is a metal film. Most coatings and plastics sheets and boards will permit the passage of water and other vapors. The exact rate of this transmission is too complicated a question to be factored in to the design of a framing package, but it can be said that the thicker the material, the slower and less efficient its transmission.

While much of the gaseous pollution which comes from our atmosphere will be sealed out by a plastic barrier, a sacrificial metal scavenger or molecular sieve is needed to give such a layer the kind of efficacy which approaches that of a metal foil. Since the metal foil will stop the passage of water vapor, it can not be safely used in framing unless the materials and environment involved in constructing the frame can be guaranteed to be conditioned in the proper range. If this can not be provided, the sealing out of pollution may be effected through the use of the plastic barrier and may be

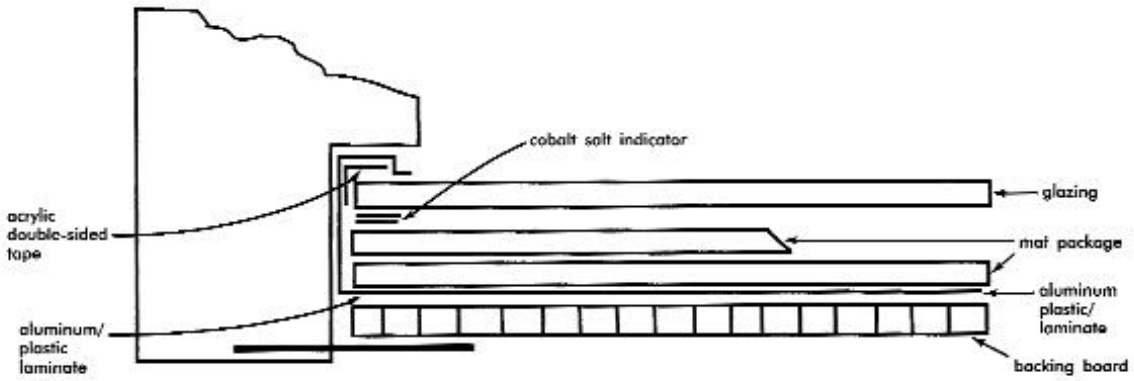


Figure 13

enhanced by the addition of the scavenging material while water vapor is allowed to enter and leave at a reduced rate.

A highly sealed packaging technique has been described in PFM October 1994. Briefly stated, this technique comprises surrounding the properly conditioned matting materials and the art which they house with a solid sheet of aluminum/ plastic laminate. The sheet of laminate is pulled around the sides of the mat package and secured to the side and the front of a sheet of acrylic or laminated glass. A double-sided pressure-sensitive tape is used to bond the matte, polyethylene side of the film to the front and edges of the glazing. If a window mat is used the film can be further fused to the tape with heat provided by a household or tacking iron set on medium high. The wrinkling of the film will reveal the establishment of the bond. If a window mat is not used and the art comes within an inch or less of the edge, the laminate should be reversed so that its shiny, nylon side will be inside, as this will give a much superior cold bond to the acrylic tape. In both cases, the excess film should be trimmed off using the same technique employed for trimming the backing paper on picture frames.

This package will have relatively high resistance to the influx of water vapor. That resistance can be multiplied by the inclusion of properly conditioned silica gel impregnated paper. This material has many times the capacity of paper to absorb and release moisture and it can buffer the contents of such a sealed package against transmission of water vapor though the glazing for much longer periods. A strip of cobalt salt humidity indicator card can be placed under the edge of the glazing , and on top of the edge of the window mat, so that it will hide from all but the most inquisitive eyes under the lip of the frame [FIGURE 13]. This will permit the owner, who has been briefed as to what to look for, to monitor the condition inside the package periodically.

Environments in which brief, unavoidable periods of high relative humidity occur can be protected against by such packaging. This package will eventually absorb dangerous amounts of moisture if left in constantly high conditions and can not be used unless there will be an alteration of high and low relative humidity. This highly sealed package is only one among many options which can be employed to shelter framed art work from environmental harm.

Pressure sensitive tapes are frequently used by framers to seal the edges of the glazing in a frame. If the tape is applied between the edge of glazing and the rabbet, it may serve to keep dust from coming under the lip of the frame for a time. There is, however, not much dust which will enter through this route if the frame has a smooth, flat lip. The grip of the tape on the frame will eventually give up.

A more common practice is the application of tape to the edges of the glazing in the front of the package and around to the edges of the backing board in the rear. This leaves the adhesive coated side of the tape pointed in toward the interior of the package and the art it contains. As the tape ages its volitiles can infuse into the package with potentially undesirable results. This problem can be overcome by facing the inside of the tape with an impervious barrier.

One simple candidate is the plastic/aluminum sheet. This material comes in long rolls which can be cut into small segments on a power miter box to produce small rolls of whatever thickness is needed to face the part of the pressure-sensitive tape which will extend around the side of the mat [FIGURE 14]. This can be applied by running the tape along

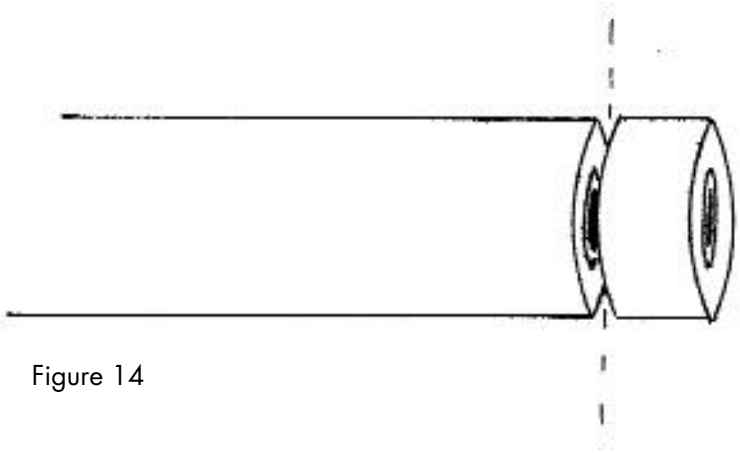


Figure 14

the face of the glass and leaving it extended from that edge while the laminate is applied to the extended portion [FIGURE 15]. If the polyethylene side is applied to the adhesive on the tape, it will be easier to reposition if it goes astray and the inert nylon side will face in toward the art. Other materials such as rolled polyester sheet can be used to perform this role but their barrier potential is not as great.

Figure 15

Any pressure-sensitive tape which is used to seal a frame will loose its hold as it ages. The more its adhesive is protected from oxygen and oxidizing gases, the longer it will maintain its bond strength. This is one the purposes in sheltering the adhesive inside the laminate in the highly sealed package described here. The material to which the tape is applied must also be considered in assessing the longevity of the tape bond. Tape stuck to metal will be sheltered by that metal and tape suck to glazing and plastic boards will also be somewhat sheltered by those materials. Aging gases can still permeate the carrier of the tape itself or penetrate from its edges, but this will be significantly less than the amount which can be expected to come through a paper board or wood.

Tapes with poor quality rubber family adhesives can be expected to oxidize and release their hold sooner than acrylic family adhesives. Tapes are not the most physically rugged method of creating a seal, but the use of gasketing and pressure sealing requires so much support structure and expense that it is not yet practical for use in commercial framing.

Having looked at some of the possibilities for sealing, it should be asked whether the creation of sealed packages has any historic precedent. If we look back to the earliest paintings we find that they are on the walls of caves which were sealed by geological accident. When the caves were opened to human visitation, their paintings began to deteriorate and the caves had to be resealed. Some of our most ancient scrolls and papyri have remained in jars in caves or tombs which were well closed for thousands of years. The beautifully preserved old master drawings we enjoy today spent most of their lives bound in volumes which remained closed and had a barrier of gold leaf applied to the edges of their pages.

More understanding and innovation in the area of proper sealing of frames will increase the utility of this option for commercial framers. Until they have the capacity to fully and carefully control and monitor the condition of the materials they use inside the frame, their sealing of packages must be limited. Today's common practice of taping the glazing to a plastic and paper backing board with pressure-sensitive tape creates a moderate degree of seal since water vapor can enter the package though the paper layer. The longevity of this seal will be further limited by the likelihood that the tape will age and give up its hold in a few years.

Hanging Devices

Having made our way to the back of the frame, hanging devices can now be considered. If properly designed and installed, this hardware will hold the frame securely on the wall and can also keep the frame from touching the wall. The importance of good hardware can not be understated. Countless accidents in which frames fell off the wall and the art they housed was damaged could have been prevented with improved hanging hardware.

Hanging hardware is generally installed on the vertical members of the frame. This distributes the weight as evenly as possible. If the hardware is installed on the top of the frame, it must be designed so that the top of the frame

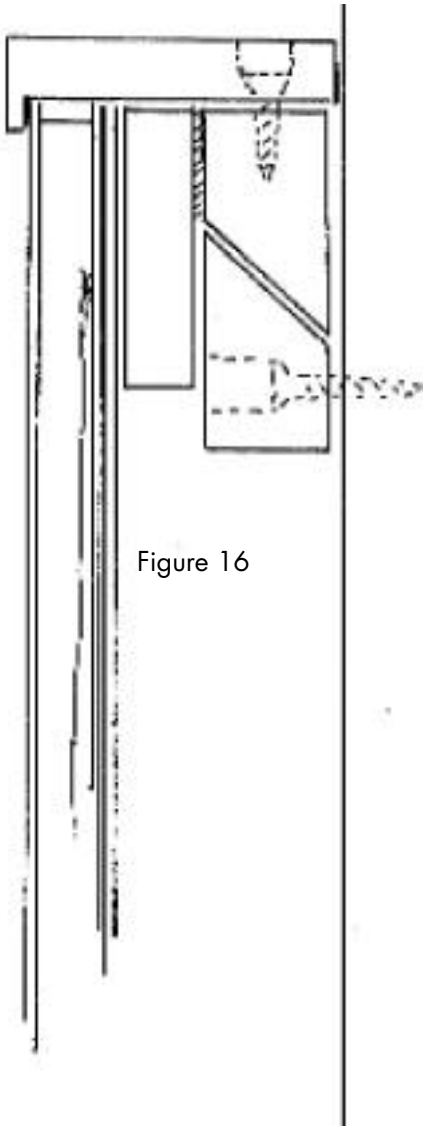


Figure 16

will not bend and eventually come loose. Placing the hardware in the center of the top member will create the greatest stress and should be avoided. If hangers are to be placed on the top, two should be set near the corners to approximate the weight distribution on hangers placed on the sides.

One rarely used method of hanging from the top of the frame can give tremendous support. A hanger bar or hanging cleat comprises a board which is split on the diagonal down its length so that half can be secured to the inside of the top of the frame or, more usually, the inside of the strainer, and the other half can be screwed to the wall. The boards need to be positioned so that the bottom of the one on the frame inclines up from the wall toward the back of the frame so it will slide down the top of the board on the wall and rest securely [FIGURE 16]. This method can spread the weight across the entire top of the frame and can support heavy material such as thick glass. The installation of the board on the wall will be rather complicated since it should be screwed to studs in the wall and should only be done by experienced personnel.

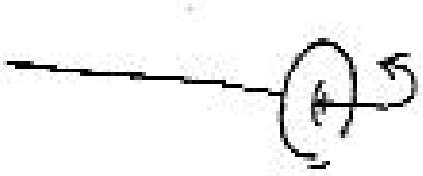


Figure 17

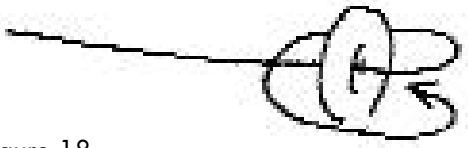


Figure 18

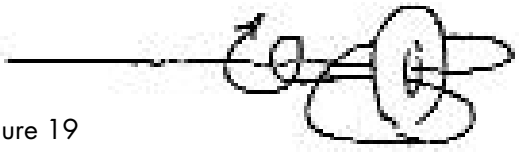
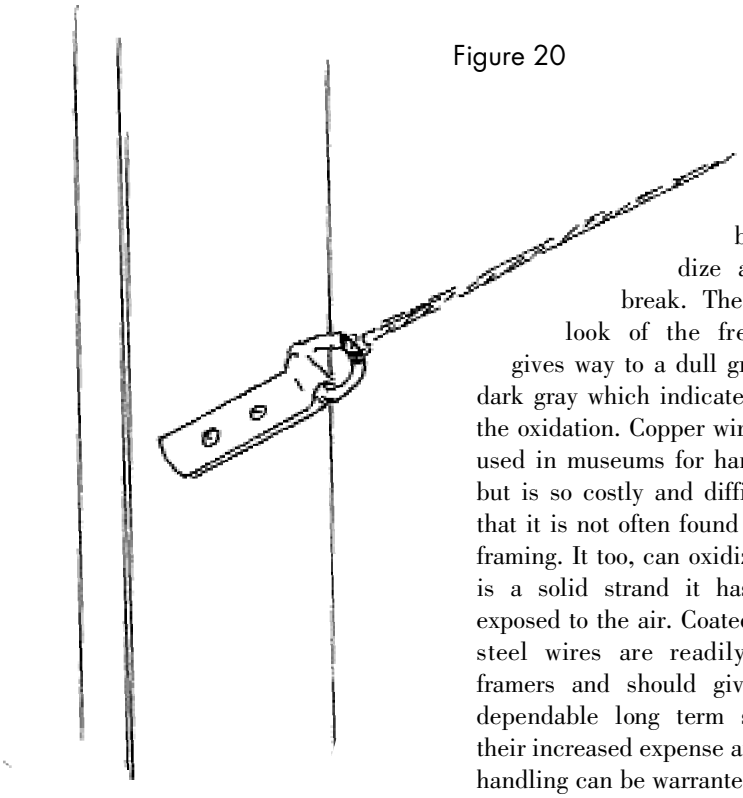


Figure 19

Most frames are outfitted with screw eyes set on the back of the sides of the frame, roughly one third of the distance down from the top. Some of the problems which may be encountered with this strategy involve the tendency of the screw eye to split the wood of the frame and the leverage the wire can have to pull the screw eye out. Drilling the frame can help to avoid splitting, but caution must be exercised to avoid drilling through the frame. This also adds time to the process and the use of a properly chosen size screw eye can render it unnecessary. The proper threading of the picture wire through the screw eye can divide the load between the two sides of the eye and can keep the wire down next to the wood of the frame to minimize the tendency of the wire to pull the eye out [FIGURES 17, 18, 19].

Another type of hardware, the "D" ring hanger, can give greater support than even the most strongly installed screw eye. The "D" ring is secured to the frame with a screw which passes through holes in its flat metal strap portion. The pull on this hanger is passed through the ring to the strap where it engages the screw as it enters the wood. This minimizes the leverage the wire has to pull on the screw. If the smallest of these hangers is used, it will have only one screw and it will rotate and follow the direction of the wire when it is pulled. If a heavier frame is being hung and a hanger is used which has more than one screw, it should be aligned so that it is in the same position, following the direction of the wire, to maximize its strength [FIG-

Figure 20



URE 20].

It may not be possible to achieve this if the sides of the frame are thin, and so another design can be used to enhance the carrying power of the frame. This strategy employs two loops of wire in place of the single strand or group of strands which usually run between the hangers. These two loops can be secured to two "D" ring or strap type hangers which are set vertically on the sides of the frame[FIGURE 21]. The complication comes when the frame is hung on the wall, since two hanging hooks must be set at the proper height on the wall. This is not as problematical as the hanging bar but should also be done by experienced personnel to avoid excessive damage to the wall from trial and error.

Even the best design will not succeed if the wire itself breaks. Aluminum oxidizes in a less dramatic fashion than iron or steel, but it will oxidize and ultimately break. The bright, shiny look of the fresh aluminum gives way to a dull gray and later a dark gray which indicates the extent of the oxidation. Copper wire is commonly used in museums for hanging pictures, but is so costly and difficult to handle that it is not often found in commercial framing. It too, can oxidize, but since it is a solid strand it has less surface exposed to the air. Coated and stainless steel wires are readily available to framers and should give much more dependable long term support where their increased expense and difficulty of handling can be warranted.

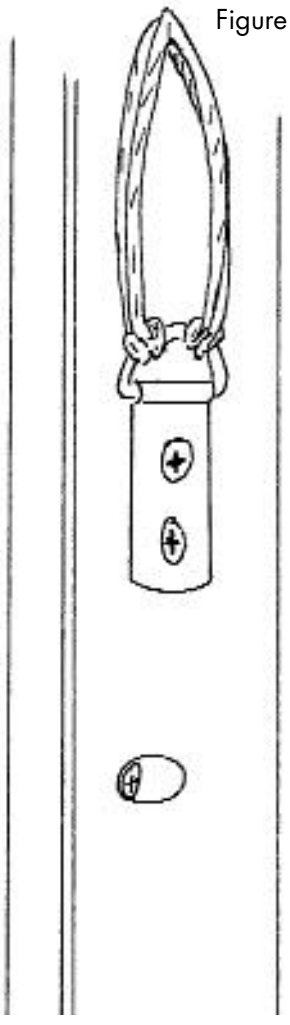
One practice which should be avoided is the use of wire running through hanging devices of the bottom of the frame to try to distribute the weight more completely. This is sometimes done through the creation of one large loop of wire which runs through screw eyes on the sides of the frame and one or more on the bottom, usually set at or near the center. As the wire is pulled down by the weight of the frame, it will pull up on the bottom of the frame and may cause it to pull out of plane. This may mean that the glazing will be resting on one spot or point and in the case of glass can lead to breakage. It can also cause deformation of the edge of the mat package which will cause it to warp.

Sectional frames have numerous types of hangers which can be slipped or screwed into their hardware channels. Those which use a screw can be expected to hold more securely over time and should hold more weight. If one of the deeper styles of frame is used to house a large work of art, the pull which wire may place on the hangers may be strong enough to begin to twist the moulding. In this case, the properly positioned strainer will solve this problem since the hanging hardware can now be set in the strainer and the weight more fully distributed.

BACKING PAPER, DUST COVERS, AND BUMPERS

Contemporary frames which have strain-

Figure 21



ers are usually considered finished when they have been assembled, even though their backing boards are exposed in back. Traditional frames require a paper dust cover for both aesthetic and preservation purposes. This layer will keep dust and grime from entering the frame package by its edges. If a ligneous paper, such as ground wood kraft paper, is used it can be expected to degrade in urban air in a matter of years and it will become weakest at the top margin where there is usually more air circulation. This is the part of the frame which is usually grasped by inexperienced handlers and the weakened paper can be expected to puncture. The result is a frame which now has a dust catcher in place of its dust cover.

To avoid this eventuality, an inexpensive conservation quality paper should be used for the dust cover. This paper should be applied dry to the back edges of the frame with a bead of polyvinyl acetate glue. The glue must be kept away from the edge where the back of the frame meets the rabbet since it can not be allowed to drip into the frame package or to dry so that it forms a crust which overhangs the edge and impedes the removal of the contents of the frame during unframing. Dampening the paper to cause it to lie flat is also unwise since it can permit dampness to invade the interior of the frame. Paper adhered with a pressure sensitive material will give up its hold in a matter of a few years, since pressure-sensitives do not adhere well to wood.

If the back of the frame is a concavity, the paper must be shaped to follow it. This situation may result when a frame with a deeper rabbet is used and a strainer is not needed. The need for this can be seen if someone tries to handle a frame which has paper applied across a hollow back. Even gentle handling can result in fingers poking though the dust cover, again, turning it into a dust collector. The dry paper should be spread across the inside of the cavity and creased at its edges. The paper can then be folded up the sides of the cavity and around to the back of the frame. There will be an excess of paper at the corners and this should be gathered into folds which will align with the corners of the cavity and can be neatly glued to the back of the frame along with the rest of the outside edge of the paper. This may sound awkward, but a bit of practice and the use of lighter weight paper will make it a ready part of the craft of good framing.

LABELLING THE BACK OF THE FRAME CAN FURTHER THE EFFORT OF PRESERVATION IF IT IS DONE CORRECTLY.

When the wall on which the frame is to hang may be suspected of being damp, the creation of an air space between the back of the frame and the wall can be added to those barriers built into the frame as a defense against the infusion of water and moisture into the frame. There are various types of bumpers on the market and many may be quite suitable. Those which nail into the frame should be installed before the frame is fitted to avoid any pounding when the art is in place.

A simple but effective bumper can be made by the application of industrial hot melt glue to the loop end of a small screw eye hanger. A group of these hangers can be screwed into a piece of cardboard and the glue can be extruded onto them so that it covers the top of the loop or eye and so that it comes together inside the eye. When they are cool, they can be screwed into the bottom of the frame with minimal risk of cracking it. The hot melt will also serve to keep the frame from sliding out of plumb as it will provide a surface which has some grip but which will not mar the wall.

Labelling the back of the frame can further the effort of preservation if it is done correctly. Pressure-sensitive labels do not hold in the long run and they expose the contents of the package to the adhesive side of the label as it ages. A stamp or water activated label is a better choice. If the label includes a note about when the framing was done and suggestions about a schedule for maintenance and unframing, it will encourage the owner to pay attention to this issue. The label can also include cautions about light, humidity, and maintenance of the frame and glazing . Any special knowledge needed for safe unframing should be noted. If, for instance, the back mat and the backing board have been attached to each other, the person who is unframing needs to know that when the backing board is lifted out the art will come with it.

Clients may need assistance with the hanging of their art. This is especially true if the frame is heavy or is to be displayed in a public space. High quality, oversize and multi-pin hangers will hold most frames, but very large frames or large frames which contain thick or laminated glass will be safer if they are somehow screwed to the wall. It is unlikely that the edges of the frame will align with the studs in the wall, so bolts

which have expanding wings which will open after the end of the bolt is slipped through a hole in the dry wall is the obvious choice. These bolts can be used as hangers with a section of their length left exposed so that wires which extend vertically up form hangers on the back of the frame can be slipped over them.

There are numerous security hangers on the market which should deter all but the most determined thieves. If time does not permit of the acquisition of such hangers, simple substitutes can be made from mending plates or screw type hardware for sectional frames. The brass mending plates can be screwed to the back of the frame along its top member, near the corners, and to the center of the back of the bottom member. The screws which are used to secure the exposed holes of the mending plates to the wall can be covered with spackling compound and painted to disguise their method of removal. If a sectional frame is being hung, the screw type hangers can be installed in reverse, so that the wire hole appears on the outside of the frame. These, too, should be placed on the top and bottom of the frame so that they will be as invisible as possible. Any thief who is willing to simply rip the frame off the will be risking the destruction of its contents and is difficult to guard against.

The Role of Framing in Preservation

Having touched on some of the problems and solutions in framing, it must be asked, how does framing fit into preservation? Frames which existed for works of art on paper up to the middle of this century could only be described as slowly destructive. The advent of rag and alphacellulose boards meant that the art would not be exposed to the ravages of degrading lignin. The availability of ultraviolet filtration rendered protection to the cellulose in the paper and to some of the media and to some pigments and dyes from light damage. The replacement of animal hide and dextrine glues with vegetable starch paste made reversibility in hinging practicable and stopped the discoloration of the paper which the glues caused. Today we are moving into an era in which the framer can work with effective barriers and scavengers to sequester the art from pollution and excessive variations in humidity. How does today's frame compare to the storage box which sits on the shelf in an institution?

One salient difference is the orientation of the art work. In the frame the art will be vertical, while it will be horizontal in the storage box. This means that gravity will hold it flat in box whether it is overmatted or floated. In the frame, gravity will not have a very great impact on an overmatted work on paper since the gentle pressure of the window mat will hold it in plane. A floated work on paper will likely suffer more from the long term effect of gravity since it will only be supported by its hinges. The unrestrained edges of the work will likely bend in response to changes to relative humidity and it may cockle more than if it were stored flat. Media such as pastel, chalk, graphite, or paint films which have cracked may also experience a loss of some of their particles as they are pulled down by gravity. This can be especially problematical if the loosened particles dislodge and settle on another part of the art, blurring its design. Indeed, resettling particles are a more troublesome problem than those which come off onto the glazing, since the latter will cause a minuscule lightening of the image but they will not blur it.

TODAY WE ARE MOVING INTO AN ERA IN WHICH THE FRAMER CAN WORK WITH EFFECTIVE BARRIERS AND SCAVENGERS TO SEQUESTER THE ART FROM POLLUTION AND EXCESSIVE VARIATIONS IN HUMIDITY.

The other important difference between the storage box and the frame is the light which the latter permits to fall on the art. The exclusion of a great degree of ultraviolet light with a filtering glazing will greatly benefit the cellulose in the paper and should slow the degradation of any lignin, but it will only provide support for some of the colors.

An owner who truly cares about a work and chooses to frame it can help it survive through continuous control of the light which falls on the frame. If the frame is hung in an interior hall way or a room which has light excluding window blinds which are kept shut except when the room is being used, the light damage can be minimized. If a decorating scheme calls for something to face a glass wall or a skylight, it should only be something which is truly expendable or totally lightfast. Thus, some of the responsibility must be placed on the owner. A consideration of the issue of why should light fall on a frame when no one looking at it may help to inform the owners hanging plans.

The storage box is usually in an area which has the best possible climate and is aided by the mass of similar material which surrounds it. A box which is filled which matted art will have a resistance to changes in relative humidity

even if the box is not a thorough barrier since its contents will be mutually protecting. The frame on the wall lacks this mass and must depend on the barrier properties of its materials if a similar resistance to changes in relative humidity is sought.

Since a mat package which has been conditioned to fifty percent relative humidity at seventy degrees fahrenheit will contain only a few drops of water, it can be sealed with scant expectation of condensation occurring. Framers will need to improve the air handling capacities of their work and storage facilities to ensure that such conditions can be guaranteed and will have to learn to handle high potential barriers such as metal foils laminated with plastics. The owner will also be called on to monitor the climate in which the sealed frame will hang to ensure that the relative humidity does not exceed the recommended levels for extended periods and that there are dry and wet cycles in proportion so that the package does not move too far in one direction or the other.

The well managed collections box has been in service for over a hundred years and has proven to operate with the preservative excellence of the properly bound volume on the library shelf. Today's most sophisticated preservation frame will filter out ultraviolet light, surround the art with chemically and physically similar material, protect the art with buffers and barriers against adverse conditions of relative humidity and pollution and may even scavenge materials which the art itself may be exuding.

Such frames are just beginning to see service and so their performance can not yet be assessed. Since the art will be vertical and exposed to some light it must be considered to be in a condition of display and not a condition of storage, but as the frame begins to approach the performance of the storage box it can begin to be considered to be an instrument of preservation. ❐

Glazing

The following is an excerpt from the Picture Framing Magazine 1993 Preservation/Conservation Framing Supplement, authored by Jared Bark.

"The ideal archival glazing material would transmit, without distortion, all the light in the visible spectrum and would block ultraviolet radiation. It would resist impact and carry no static charge. Available in any size, this material would also be lightweight, rigid, and show no effects of aging. To satisfy other framing requirements, it would be non-reflective, abrasion resistant, and neither expand nor contract with changes in temperature and humidity. Sad to say, no miraculous glazing material exhibits all of these qualities. At best, or options today satisfy only three or four of the dozen requirements listed above. Our task, then, is to sort out the best choice for each circumstance.

In the paragraphs below I compare a number of attributes of glass and acrylic (polymethyl methacrylate) glazing. I have omitted an discussion of polycarbonate, a virtually unbreakable sheet with UV shielding properties, because it is so rarely required. Discussions of abrasion resistance, expansion and contraction, and weight have also been ommitted.

In choosing which glazing sheet to use, a number of questions must be considered.

1. Is the work susceptible to UV damage?

2. Under what lighting conditions is the work likely to be displayed?

3. Is it likely that the work will be shipped?

4. Is the media loose?

5. How stiff is the paper support?

Aging:

The only aging process glass is subject to which may be of interest to framers is that, with time, microscopic surface scratches may slightly reduce light transmission. Acrylic, like all organic materials, ages, but very slowly. Some tests have shown that it loses a small percentage of light transmission and yellows slightly over a number of years of heavy weathering. These losses are so modest that they are unlikely to be perceptible to the human eye. There is much concern among framers that the UV absorbing acrylic glazing may diminish with time, but so far studies have shown no loss of protection.

Emissions/Outgassing

Picture framing glass is not know to cause any problems by emission of gasses or liquids. Acrylic sheet, theoretically, may emit small quantities of monomer after manufacture. Engineers at major U.S. manufacturers, however, have found their products emit very little, if any.

Deflection and Thickness

Glass is rigid, and in picture frames deflection is barely perceptible and unlikely to pose a risk to framed art. Acrylic sheet is flexible and subject to deflection, which distorts reflections.

The major concern of framers is that acrylic glazing may bow in, touching a framed work of art. This likelihood is increased by lighting conditions; in tests we have performed, the interior of a frame lighted with incandescent exhibition lights was found to be from 5 to 6 degrees warmer than the outside air. This difference may be enough to cause the glazing to slightly inward. Over time, difference in relative humidity inside and outside the frame or case may also cause deflection, with the acrylic bowing toward the more humid side.

Because of the risk of acrylic bowing into the frame, I do not recommend using sheets thinner than .118" (3 mm), although .098" material (2.5 mm) is used by framers in small frames. We commonly use .118" sheet up to about 40"x40". Above these dimensions, 3/16" sheet is preferable, and 1/4" acrylic may be used on the largest pieces.

Since acrylic glazing is subject to horizontal deflection, it should never be shipped lying flat. Horizontal bowing of 1/8" acrylic, size 36"x36", is 6/16";

Appendix

Information concerning specific product information has been updated for this partial reprint.

for 48"x48", bowing is 1/2". Clearly, unless very deep mats or spacers are used, it is likely that horizontally shipped acrylic glazing will contact, and vibrate against, the surface of the framed work of art.

Impact Resistance

Picture glass easily shatters. It a frame glazed with picture glass must be sipped, the glass should be carefully taped. Laminated sheets of glass are said to be much more impact resistant, but I have not seen any of the test results.

The imact resistance of acrylic glazing is several times that of picure glass. This property is almost unaffected by changes in temperature. The impact resistance of acrylic is great enough that it rarely cracks or breaks in shipping, and if it should the broken edges are not as sharp as glass. For these reasons, and because tape removal can be difficult, it should not be taped.

Static Charge

Glass is not a good conductor, but its surface properties are such that an electrostatic charge rarely poses a problem in framing.

Acrylic sheet is subject to a high static charge, especially when humidity is low. Anti-static acrylic cleaning solutions will reduce the charge temporarily, but at present there is no practical means of permanently reducing the charge. Loose media, such as charcoal, chalk, or pastel, and thin or lightly sized papers (such as Japanese papers) will be attracted to static charged acrylic glazing. Increasing the distance between acrylic and framed artwork lessens the attraction, but to be effective a separation of several inches may be necessary. Glass would be a better alternative when framing these materials.

Thermal Conductivity:

Glass is a fairly good thermal conductor and a poor thermal insulator. In practice, this means that in conditions of rapid and/or significant changes in temperature or humdity, condensation may form on the inner surface of glass in a frame.

Acrylic is a poor thermal conductor and a good thermal insulator. Temperature or humidity spikes are less likely to cause condensation problems on the surface of acrylic than on glass. Acrylic provides a somewhat greater measure of thermal protection to fram d art.

Ultraviolet Protection

Standard picture glass absorbs almost all ultraviolet radiation up to 340 nanometers (ultraviolet rays range from 300 to 400 nanometers). There are now several glass sheets which absorb at least 97% of UV rays up to the 380 nanometer range. Some of these are coated and other have a laminated sheet between two sheets of glass. Suppliers include Denglass, Sandel, Tru Vue, and Zuel. Acrylic suppliers such as Atohaas, CYRO, and ICI Acrylics, and Plaskolite offer a range of UV filtering sheets, each with different properties. The best of these provide 99% UV blocking in the 300 to 400 nanometer range."

Editor's note

Since the publication of our 1993 Preservation/Conservation Framing supplement, various new glazing products have come to the market. The most up-to-date information has been added to the Ultraviolet Protection discussion reprinted here. Framers will also want to consider that water white, or low-iron, glass (which has a higher rate of transmission than regular float glass) has recently come to the market, as has abrasion-resistant acrylic. Certain glass and acrylic suppliers have also expanded their range of ultra-violet filtering products.