14. Envelopes and Sleeves for Films and Prints

Recommendations

Enclosure Materials:

- **Recommended:** Uncoated transparent polyester (e.g., DuPont Mylar D and ICI Melinex 516). Also suitable are uncoated polypropylene (e.g., Hercules T500 film) and certain nonbuffered 100% cotton fiber papers (e.g., Atlantis Silversafe Photostore). Probably satisfactory is high-density polyethylene (recommended as the best available low-cost material for amateur photofinishing applications).

- **Should be avoided:** Low-density polyethylene (e.g., Print File, Vue-All, and Clear File notebook pages and sleeves); cellulose acetate (e.g., Kodak Transparent Sleeves); polyvinyl chloride [PVC] (e.g., 20th Century Plastics vinyl notebook pages); surface-treated polypropylene (believed acceptable for slide pages, however); conventional glassine; acid-free glassine; kraft paper and most other common types of paper; matte polyester (e.g., DuPont Mylar EB-11); and synthetic paper-like materials (e.g., DuPont Tyvek).

Enclosure Design:

- **Recommended:** Top-flap sleeves (preferably made of uncoated transparent polyester; as a second choice, uncoated polypropylene is probably acceptable). These sleeves allow films and prints to be inserted and removed without sliding against the enclosure surfaces, thus avoiding scratches (available from Talas Inc. and Light Impressions).

- **Acceptable:** High-density polyethylene sleeves of the types often used in amateur photofinishing (commonly referred to as "sleeving material"). Although they require that negatives slide against the plastic surfaces during insertion and removal, high-density polyethylene sleeves appear to have minimal tendency to cause scratches and have otherwise proven to be generally satisfactory for applications that require low-cost enclosures.

- **For additional protection:** All sleeved films and prints, either singly or in groups, should be stored in high-quality, top-flap paper envelopes for protection from dust and physical damage, and to allow marking with rubber stamps, pens, etc.

Envelopes, sleeves, and other enclosures for long-term storage of photographs must meet three fundamental requirements:

1. The design of an enclosure — and the surface characteristics of the materials used to make it — must not cause scratches and abrasion to films and prints during storage and use. This requirement is not met by most currently available photographic enclosures because it is necessary to slide films and prints against the enclosure material during insertion and removal.

2. Materials and adhesives used to make the enclosures must not be hygroscopic (attracting moisture from the surrounding air), nor contain any chemicals that could cause, or contribute to, fading or staining of black-and-white or color photographs during the intended storage period. In museum collections, most photographs will be kept for hundreds or thousands of years. Unstable materials, including poor-quality paper, glassine, and polyvinyl chloride (PVC), may over the years produce harmful decomposition products, stick to emulsions, exude gooey plasticizers, or cause other types of damage to photographs.

3. To provide adequate physical protection during the life of a photograph, the materials used to make an enclosure must retain sufficient physical strength and tear resistance for as many years as the photograph inside is to be kept. Because a photograph is likely to be retained even after the image has significantly deteriorated, the enclosure material should have aging characteristics which are at least as good as the photograph's paper or plastic support material.

The requirements for enclosure materials suggest that the relatively few plastics and high-quality nonbuffered papers suitable for making print and film bases logically could also be used to make filing enclosures. If the material is nonreactive and stable enough to be used as a photographic support material, it should be equally satisfactory as an enclosure material.

When storing comparatively unstable films, such as color negatives made with Kodak Kodacolor II and Vericolor II, pre-1989 Agfacolor XRS and XRG, and pre-1992 3M ScotchColor films (which are significantly less stable in dark storage than current Kodak Vericolor III and 400, Ektar, and Kodak Gold Plus; Fujicolor Super HG, Super G, Reala, and Fujicolor Professional 400 and 160; and Konica Super SR, GX, Super DD, and XG films), the permanence

1979

Thomas Beecher, a staff member at the Library of Congress in Washington, D.C., and Beverly W. Brannan, curator of documentary photography in the Prints and Photographs Division of the library, examine color transparencies in the **Look Magazine** collection. The **Look** collection was donated to the library after the magazine ceased publication in 1971. The transparencies and negatives are still in their original, less-than-ideal sleeves and envelopes, although the films likely will be put in new, higher-quality enclosures at some point in the future. Films and prints in most institutional and private collections, however, are destined to remain in their original enclosures for as long as they are kept. To avoid cumulative damage to photographs caused by unsuitable filing materials, it is essential to use safe and long-lasting enclosures right at the outset. (Since this photograph was taken in 1979, the color transparencies in the **Look** collection have been moved to the library's cold storage facility in nearby Landover, Maryland.)

requirements for the enclosure material are in general less stringent than they are for the longer-lasting color films — and, of course, for black-and-white negatives.

Likewise, enclosures for older, less stable color prints such as those made with Ektacolor 37 RC and 74 RC paper, need not be of the same high quality as is required for storage of the much longer lasting Konica Color, Ektacolor, Agfacolor, and Fujicolor papers introduced during 1984–1985, or for storage of the most stable types of prints, including Ilford Ilfochrome (called Cibachrome, 1963–1991), Kodak Dye Transfer, and Fuji Dyecolor color prints, and black-and-white prints, which, when kept in the dark, have the potential to remain in good condition for many hundreds and perhaps even thousands of years. UltraStable Permanent Color prints and Polaroid Permanent-Color pigment prints, which are extremely stable both on display and in dark storage, of course also require very long-lasting storage enclosures.

But regardless of how good or poor the inherent image stability of a particular film or print may be, the enclosure material should not in any way contribute to, or speed up, the deterioration of the image or of the base material. As a practical matter, most photographers and collecting institutions will want to use the same type of enclosure for everything in their collections — and this means that only the very best, most stable enclosures will suffice.

Avoiding Scratches and Other Damage Caused by Enclosures

A fundamental requirement in the design of any photographic enclosure is that a film or print can be inserted or removed without sliding it against the surfaces of the enclosure material. Sliding a negative in and out of an enclosure will, over time, almost certainly result in scratches; the longer a negative or color transparency is kept — or the more valuable it is — the more likely it is that it will be repeatedly accessed and printed. The more it is handled, the more likely it is to be scratched or otherwise physically damaged.

As any photographer knows who has laboriously attempted to retouch an enlargement printed from a scratched 35mm negative, every possible precaution should be taken to avoid even minor surface scratches on negatives. Scratches on transparencies are especially troublesome because they will show up on prints as black lines which must be chemically bleached before they can be retouched with spotting dyes — a time-consuming and difficult task. Although the enclosure material itself may be soft enough not to scratch delicate gelatin emulsions, particles of dust and grit inevitably become sandwiched between the enclosure and film surfaces. As film is dragged across even a tiny particle of grit, the emulsion or base can be scratched. Stiff plastic enclosure materials are particularly prone to cause grit-related scratches. In this author's experience, PVC enclosures are the most likely to cause scratches on films as they are slid in and out; among plastic materials, high-density polyethylene appears to have the least tendency to cause scratches during use.

Charges of static electricity which can develop as a film or print is inserted and removed from a plastic enclosure — especially in low-humidity conditions — cause an attraction between the film and enclosure, increasing the likelihood of scratches.

An enclosure should be designed so that it can be opened like a book, allowing a film or print to be lifted out without touching the enclosure material. This non-sliding requirement alone eliminates from consideration most of the envelopes, sleeves, and notebook filing pages currently on the market.

Enclosures for negatives, unmounted transparencies, and prints are discussed in this chapter. Although information on PVC, polypropylene, and other plastics used to make 35mm slide pages is included in this chapter, discussion of the practical aspects of these products is found in Chapter 18, *Handling and Preservation of Color Slide Collections.*

Types of Enclosures

Photographic enclosures have been made with many different paper and plastic materials, and supplied in a vast number of configurations. They can be divided into twelve groups:

1. **High-density polyethylene sleeve for automatic negative sleevers.** Many professional labs, photofinishers, and mini-labs return 35mm negatives in plastic sleeves which are made with edge-sealed negative compartments side-by-side in a row, with one end of each compartment open. Nearly all sleeves of this design are made of translucent, high-density polyethylene, and most are manufactured in Japan. Often imprinted with the name of the photofinisher, the sleeves are now the most common kind of negative enclosure — in the U.S. alone, many millions are used every week. Negatives are cut — most commonly to 4-frame lengths — and inserted into the sleeves with manually operated or high-speed automatic machines. With negatives inside, the sleeves are folded accordion-fashion and placed in customers' print envelopes. Negative strips can also be cut with scissors and manually inserted into the sleeves. When made of high-density polyethylene (low-density polyethylene is *not* recommended), the sleeves appear to be reasonably satisfactory if kept in a photofinisher's envelope, standard paper letter envelope, or other enclosure to prevent contamination with dust and dirt. The naturally "slippery" and non-clinging surface of high-density polyethylene is much less likely to cause scratches on films than most other types of enclosure plastics. High-density polyethylene sleeves are obviously superior to the open-end yellow paper folders in which negatives are returned to customers by Kodalux photofinishing labs; with an entire roll of negatives cut to random lengths stuffed into each folder, the Kodak folders offer little protection to individual negatives.

2. **Plastic sleeve with uncemented top flap.** Usually made of transparent uncoated polyester, polypropylene, or cellulose triacetate, this sleeve can be opened like a book to allow the film or print to be lifted out, avoiding the possibility of scratches. Both ends are open and adhesives are not used. Used in combination with high-quality top-flap paper envelopes (No. 8 below), this is the recommended design for most applications. Stable and chemically inert uncoated polyester is the best material with which to make these sleeves; "matte" surface polyester such as DuPont Mylar EB-11, which is impregnated with abrasive silicon dioxide, should be avoided. It is *absolutely essential* that the sleeve have very tight and crisp folds to minimize the chances of a film accidentally sliding out of either end of the closed sleeve during handling. Top-flap polyester sleeves used in combination with high-quality top-flap paper envelopes provide the best protection of any currently available filing system. (See **Figure 14.1.**)

3. **Plastic sleeve heat-sealed around uncut roll films.** Similar in appearance to plastic negative tubes, these sleeves consist of two transparent plastic strips (most commonly made of heat-sealable polypropylene) that are sealed on both edges around uncut roll films with special heat-sealing equipment; for protection from dust and scratches during handling in the lab, films are usually sleeved immediately after processing. The cut ends of the sleeves are not sealed and remain open. The sleeves are most commonly used with 120 and 220 roll films but are also applied to 35mm films when customers request that a lab return rolls uncut. The roll-length sleeves with film inside are generally cut with scissors into lengths of the desired number of frames. For protection from dust, cut lengths of sleeved film should be stored in paper envelopes. Once films are removed from the sleeves, this author recommends that the sleeves be discarded and films placed in top-flap polyester or uncoated polypropylene sleeves, also kept inside of paper envelopes. In recent years, hot-seal sleeves have become popular in professional processing labs, especially for housing transparency roll films. Automatic heat-sealing equipment and plastic sleeving material are supplied by Climax, Ltd. and other firms (see **Suppliers** at the end of this chapter). At the time this book went to press, no information was available

on the long-term effects of these sleeves on stored color or black-and-white films, but they are believed to be reasonably safe.

4. **Sleeve with cemented top and bottom seams.** Generally made of transparent cellulose triacetate, polypropylene, polyvinyl chloride (PVC), or polyester, this type of sleeve has traditionally been used for roll and sheet color films. Sometimes referred to as "sheaths," Kodak Transparent Sleeves, made of cellulose triacetate, are of this design. Because the film or print must slide against the surfaces of the enclosure each time it is inserted or removed, there is a significant danger of scratching. The design is not recommended for either long- or short-term applications. Some sleeves with cemented top and bottom seams have one side made of a "matte" translucent plastic to serve as a diffuser when viewing the enclosed transparency or negative. The translucent portion of such sleeves is usually made of low-plasticizer-content PVC, with the transparent front made of either PVC or cellulose acetate. This type of translucent-back sleeve has most frequently been used with sheet transparency films, especially those in the 4x5-inch and 8x10-inch format.

5. **Notebook page.** Once made of glassine, these are now usually made of low-density polyethylene, plasticized polyvinyl chloride (PVC), polypropylene, and, occasionally, cellulose acetate or high-density polyethylene. Intended to be stored in a three-ring binder, the pages are made in a wide variety of configurations, nearly all of which require that a film or print be slid in and out of a pocket or open-ended compartment. Some filing pages are intended to be stored flat, in boxes, and are not punched with ring-binder holes; others fold up into attached paper wallets (some wallet enclosures are made of translucent high-density polyethylene). As a matter of convenience, many photographers expose contact sheets with negatives in the pages even though this results in contact images of reduced resolution. With the exception of polypropylene pages designed for mounted 35mm slides, none of the currently available notebook page enclosures are recommended. Plasticized PVC pages in particular should be avoided.

6. **Negative tube.** Usually made of low-density polyethylene, these are supplied as flattened tubes in long rolls. Intended for 35mm and 120/220 roll films, they are cut to length by the user, leaving both ends open. Because the plastic tubes require that films slide against the surfaces of the tube during insertion and removal, they are not recommended; low-density polyethylene negative tubes in particular should be avoided.

7. **Print and negative "wallet."** Most amateur prints are returned to customers in wallets made of paper, plasticized polyvinyl chloride (PVC), or, less commonly, high- or low-density polyethylene. Wallets are supplied in many configurations but basically consist of a folded envelope with a wide, unsecured top flap that frequently extends to the full depth of the enclosure. Some wallets have a print and negative storage compartment in the top flap as well as the bottom of the enclosure; PVC wallets are generally made with transparent interiors so that the contents are visible when open. Even though Kodak has frequently advised that plasticized PVC should be avoided for storage of photographs, since 1983 Kodak Processing Labs (now Kodalux Processing Services) have supplied wallets made of this unsafe material with its "premium" Magnaprint 35 Service for oversize 4x6-inch prints from 35mm negatives. Much safer is the yellow two-compartment, heavy-weight paper envelope that Kodak (now Kodalux) has for many years supplied with standard-size prints (one compartment accommodates the prints and the other holds a separate paper folder containing the negatives). This enclosure has a design that combines certain features of a paper wallet with the overall concept of a paper envelope with a protective top flap.

8. **Envelope with protective top flap.** Usually made of paper, this is similar in design to the ordinary mailing envelope. Less common than the envelope without a protective flap, this design is very effective in keeping enclosed films or prints free from dust and dirt. Properly made *with narrow and thinly cemented* edge seams on both sides *(with the two flaps adhered to the outside of the envelope),* an ungummed top flap, and with a folded, seamless bottom, this type of envelope is ideal for use in combination with top-flap polyester sleeves (No. 2 above). A film or print is first placed in a polyester sleeve, which is then put in the envelope. The transparent sleeve protects the film or print from fingerprints and external chemical contamination during examination, handling, and storage. The paper envelope protects the sleeve and photograph from dust and abrasion and also provides a convenient surface for written information, filing numbers, and rubber-stamp impressions. Up to 10 films or prints in individual sleeves can be placed in each envelope. (See **Figure 14.2**.)

9. **Envelope without protective flap.** Sometimes known as a "jacket," this is the traditional negative filing enclosure. Sealed on three sides, with one end left open, it is usually made of paper, glassine, or high-density polyethylene. (Flat, low-density polyethylene bags, often used for storage of both mounted and unmounted prints, are included in this group.) These envelopes are often made with a thumb-cut at the top to facilitate negative removal. The design has a number of drawbacks and is not recommended for long-term storage applications; in particular, paper or glassine envelopes with a glued seam in the center should be avoided. If for reasons of economy this type of enclosure must be used, edge-sealed high-density polyethylene envelopes appear to have the least potential for harm to films and prints.

10. **Folder.** Usually made of paper or glassine, some folders have a glued seam on one end and some are made with both ends open. Folders are generally made without a top flap. Folders are intended to be placed into envelopes after films or prints are inserted between the two sides of the folder. With the exception of Kodak

(now Kodalux) photofinishing labs, which have for many years returned cut rolls of negatives in a paper folder (some made with a top flap and a glued seam on one end, and others made without a top flap and with both ends open), this type of enclosure is no longer commonly used. Because groups of negatives can easily fall out of the open top and/or open ends of a folder, and little protection from dust and dirt is provided, this type of enclosure is not recommended.

11. **Heat-sealable vapor-proof envelope.** Supplied in a variety of sizes by Light Impressions Corporation, Conservation Resources International, Inc., and several other companies, these special envelopes are made of a paper- or plastic/aluminum-foil/polyethylene laminate; they are similar to the envelopes used by Kodak and other manufacturers to factory-pack sheet films. Because paper and plastics are permeable to water vapor, the aluminum-foil layer is needed to provide a moisture barrier. Intended for protecting color films and prints in cold storage with uncontrolled relative humidity, the envelopes must be replaced each time they are opened. They are not recommended by this author for other than cold storage applications (see Chapters 19 and 20). Envelopes of this type in 4x5- and 8x10-inch sizes were supplied by Eastman Kodak for a number of years; called Kodak Storage Envelopes for Processed Film, they were discontinued by Kodak in 1987, apparently because of lack of demand.

12. **Four-flap paper enclosure.** This is a specialized design of paper enclosure, favored by some museums and archives, especially for storage of glass plates. The plate or negative is placed in the center of the enclosure and the four flaps, each the size of the negative, are successively folded over it. The enclosures are prescored for ease of folding. Advantages of the design are freedom from scratching during insertion and removal of the negative, and the absence of potentially harmful glues in the enclosure. Three-flap versions of this enclosure are not recommended. In this author's view, four-flap enclosures are not as satisfactory as top-flap polyester sleeves used in combination with top-flap paper envelopes.

Plastic Enclosure Materials

A great advantage of transparent plastic enclosures over paper envelopes is that negatives, transparencies, and prints can be viewed without having to remove them from the enclosure. This not only speeds up examination of negative and print files but also helps to avoid fingerprints, scratches, and other sorts of physical damage. With paper enclosures, films and prints must be removed every time they are looked at. During the last decade, the popularity of plastic enclosures has markedly increased, and in most branches of photography they have almost entirely displaced paper and glassine enclosures.

Plastic enclosures can be fabricated easily with high-speed thermal, ultrasonic, or radio-frequency sealing equipment,[1] which eliminates the glues required for paper and glassine envelopes. Many of these glues contain ingredients which can cause discoloration and fading of prints and negatives stored adjacent to cemented seams; such problems can be especially severe when the photographs are stored in humid conditions. Many commonly used glues are hygroscopic and increase localized moisture content of the paper — as well as of films or prints — in the vicinity of glued envelope seams, accelerating fading and discoloration in these areas.

Although plastic enclosures have many advantages, they also suffer from a few drawbacks. They are, for example, difficult to write on; with most types of plastics, only inks from solvent-dye felt-tip markers such as Sanford's Sharpie or Pilot Photographic pens will satisfactorily adhere to the surface. However, if plastic enclosures are inserted into a paper envelope, negative numbers, caption information, and rubber-stamp impressions can easily be put on the outside of the envelope.

Another objection to plastic enclosures is that they tend to develop static electrical charges, which attract and retain dust and dirt, especially when the relative humidity is low. During handling, polyester is particularly likely to develop static charges. This problem can be minimized by keeping darkrooms and other work areas clean and by storing the plastic enclosures in paper envelopes or boxes.

Concern has been expressed that moisture may become trapped in plastic enclosures, and that they are more likely to cause sticking or areas of irregular surface gloss (often called ferrotyping) on the emulsions of films and prints, especially when stored in high humidities. Examination of many commercial and historical collections containing films and prints packaged in glossy acetate sleeves — as well as films stored in groups so that the emulsions are in tight contact with the smooth surfaces of adjacent films — suggests to this author that with polyester and cellulose acetate enclosures, this alleged danger has been greatly exaggerated.

When storage temperatures and humidities are reasonable, and films or prints are not crammed into files or large boxes (or otherwise stored under pressure), there appears to be little likelihood of sticking problems with enclosures made of uncoated polyester, untreated polypropylene, high-density polyethylene, or cellulose triacetate. If, however, photographs must be stored for long periods in conditions of high relative humidity, it is suggested that a sheet of suitable paper, cut to the same size as the film or print, be placed between the enclosure and the emulsion side of the film, or that the film or print be put in a thin paper folder of proper size before placing in the plastic envelope.[2]

This author has observed a number of instances of print and film emulsions sticking to enclosures made of low-density polyethylene, surface-treated polypropylene, and plasticized PVC; for this and other important reasons cited later, it is recommended that these materials be avoided for storage of films and prints.

Kodak has pointed out an additional drawback of polyethylene enclosures:

> . . . if a fire occurred in the immediate vicinity of the storeroom, heat that would not destroy negatives on acetate film base, nor even scorch good-quality paper, might melt polyethylene and thereby damage negatives.[3]

In a disastrous 1982 fire at the Design Conspiracy Color Lab in Oakland, California, many negatives and prints belonging to San Francisco area fine art photographers were destroyed. As salvage efforts revealed, "Some negatives in storage fared reasonably well, although different types of storage containers withstood heat and water with varying degrees of success. Most negatives in plastic [low-density polyethylene and PVC] were lost when the plastic melted onto the film."[4] The low melting temperature of polyethylene and plasticized PVC is an additional reason that these plastics are inferior to polyester for storage enclosures.

Identifying Polyester, Cellulose Triacetate, and Other Plastic Enclosure Materials

Uncoated polyester and cellulose triacetate are both glass-clear materials and very similar in appearance. They can be differentiated by two simple tests:

1. Using just the fingers, it is almost impossible to initiate a tear in polyester. Cellulose triacetate tears rather easily. In an equivalent thickness, polyester is much stiffer than cellulose triacetate. (If an identified sample is needed for comparison, Kodak Estar Base sheet films are made of polyester.) Most Kodak black-and-white and color 35mm and larger roll films are made with cellulose triacetate.

2. Cellulose triacetate is soluble in certain solvents, such as methylene chloride. When dipped in methylene chloride, the material will become sticky and pieces may become cemented together. Polyester is virtually unaffected by solvents at room temperatures. This test should be done with adequate ventilation since the solvents are toxic to breathe.

Other common plastics for making photographic storage enclosures are low-density polyethylene, high-density polyethylene, and polypropylene, none of which is soluble in methylene chloride. Transparent grades of low-density polyethylene are slightly milky in appearance, very flexible, and can be stretched considerably without tearing or breaking; high-density polyethylene is a milk-white translucent material, somewhat similar in appearance to glassine paper, and stiffer than low-density polyethylene. Polypropylene, which is discussed later, may be hard to distinguish from polyester on the basis of simple tests. As with polyester, it is difficult to initiate a tear in polypropylene. Both plastics tear fairly easily once a tear has been started (by making a small cut with a pair of scissors, for example), but polyester tears with a rough, somewhat jagged edge whereas polypropylene tears with a much smoother edge.[5]

Plasticized PVC is a flexible, glass-clear or translucent plastic, usually of fairly heavy gauge when used for slide notebook pages and, less commonly, to hold negative strips. Heavily plasticized PVC usually has a pronounced odor when held close to the nose. Thin gauges of low-plasticizer-content PVC (used in some cemented top- and bottom-seam sheet film and roll film sleeves) may be difficult to distinguish from cellulose acetate or polypropylene.

Polyester Film and Print Enclosures – Highly Recommended

Uncoated polyester is, because of several unique attributes, the preferred material for photographic enclosures. A glass-clear plastic technically known as polyethylene terephthalate, polyester is produced by a number of companies in the U.S. and other countries. In the U.S., DuPont Mylar is probably the best-known commercial polyester sheet material (DuPont manufactures over 60 types of Mylar); Eastman Kodak produces polyester film base under the Estar name.[6]

About 25 years ago, polyester began to replace less expensive cellulose triacetate as a film base for some products, especially graphic arts films; because polyester is stiffer than cellulose triacetate of the same thickness, it is particularly well suited for sheet films and reflection print materials. Cellulose triacetate continues to be used as the support material for most 35mm and 120/220 roll films such as Kodak T-Max 400, Tri-X Pan, Vericolor, Ektar, Kodak Gold, and Ektachrome. Polyester is the current base for such products as Kodak Gold Disc film, Kodak Estar Base black-and-white and color sheet films, Ilford Ilfochrome (formerly Cibachrome) Micrographic film, and Polaroid PolaChrome instant color slide film. A special opaque white Melinex polyester base material made by the British firm Imperial Chemical Industries, Ltd. (ICI) is used with Ilfochrome Classic (formerly Cibachrome II) glossy-surface prints, UltraStable Permanent Color prints, Polaroid Permanent-Color prints, and Kodak Duraflex RA Print Material. A similar if not identical polyester material is also the base for Konica Color QA Super Glossy Print Material and Fujiflex SFA Super-Gloss Printing Material. Polaroid Spectra prints (called Polaroid Image prints in Europe), Polaroid 600 High Speed prints, and Polaroid SX-70 prints all have polyester front and backing sheets.

Polyester is an extremely stable and long-lasting plastic. Recently published studies by Kodak indicate that in dark storage Estar polyester film base is at least six times more stable than cellulose triacetate film base and that the physical properties of polyester are predicted to remain unchanged "for several thousand years."[7] The stability advantages of polyester over cellulose triacetate are even greater under adverse storage conditions of high relative humidity. In dark storage, polyester sheet is believed to be more stable than even the best-quality 100% cotton fiber paper; polyester will probably last as long as any type of photograph in existence. Extensive experience with it as a film base, coupled with accelerated aging tests, indicates that polyester is essentially nonreactive with black-and-white and color images, even under extreme temperature and humidity conditions.

In this author's accelerated dark-storage tests at 144°F (62°C) and 45% RH, DuPont Mylar D uncoated polyester sheet and the polyester base materials of Cibachrome (now Ilfochrome) prints, UltraStable Permanent Color prints, and Cibachrome (Ilfochrome) Micrographic Film proved to be far more stable than the cellulose triacetate base materials used with Kodak, Fuji, and Agfa 35mm films; the polyester materials were also much more stable than the fiber-base paper support of Kodak Dye Transfer prints. After 1,000 days (2.7 years) of accelerated aging, the cellulose triacetate film bases had shrunk, smelled of acetic acid, and had become grossly deformed, while the polyester materials appeared *totally* unaffected.

Uncoated polyester is naturally flexible and contains no plasticizers which might exude or volatilize over time and damage films or prints. Polyester is not affected by most solvents and has a very low rate of moisture transmission, which will partially protect enclosed photographs from rapid fluctuations in relative humidity.

Polyester has a low permeability to gases and thus affords significant protection to photographs from atmospheric pollutants and/or harmful chemicals from materials such as improperly processed photographs or low-quality paper. This feature may be particularly important to museums and archives because of the great variety of photographs — many of which have not been processed and washed correctly — likely to be in their collections. Harmful chemicals from poor-quality mount board and envelopes, as well as from incorrectly processed photographs can migrate through adjacent paper envelopes and contaminate prints and negatives.[8] Polyester is far superior to paper as a chemical barrier between adjacent photographs. Storage in contact with polyester will not alter the pH of a photographic material, an important consideration with some color materials.

Polyester is very tough and tear-resistant — for the same degree of physical protection, it can be used in thinner gauges than cellulose triacetate. Unlike thin cellulose triacetate, polyester sheets lie very flat and do not develop surface ripples or waves, even in large sizes. Any surface ripples in a film or print enclosure can "rock" on the delicate emulsion or base surfaces during storage, producing surface abrasion which can in some cases cause severe damage to a photograph. This is most often seen with sheet film stored in tightly packed vertical files; any dust or other particles of dirt on the film or acetate enclosures will exacerbate the problem.

If enclosures are made of *uncoated* polyester, such as DuPont Mylar D or ICI Melinex 516, there is assurance that they will be photographically safe and perform as expected. Cellulose triacetate, on the other hand, is made in many grades by a number of manufacturers. Most brands probably will not harm photographs, but only those types specifically designed as a film base, such as Kodak Kodacel, may be assumed to be safe.

Design of Polyester Sleeves

Until recently, polyester was not used extensively to make photographic enclosures because it is somewhat more expensive than cellulose triacetate and it cannot be fabricated with conventional solvent cementing techniques. Polyester also cannot be heat sealed or properly heat folded with conventional fabricating machinery. In the last few years, however, ultrasonic heating equipment which permits effective welding and folding of polyester enclosures has become widely available in the plastics industry. The first commercially available uncemented top-flap polyester film and print enclosures were introduced in 1976 by Talas Inc., in New York City, employing designs suggested by this author (see **Figure 14.1** and **Table 14.1**).

Similar clear polyester sleeves are sold under the Fold Lock name by Light Impressions Corporation. Recent samples of sleeves from Light Impressions were made with tighter folds than sleeves generally supplied by Talas — a significant advantage because tight folds tend to prevent films from slipping out of the ends of the sleeves. Talas sleeves are made of 4-mil (0.004-inch) Mylar D, which is about twice as thick as the Mylar D in those supplied by Light Impressions. This author prefers Light Impressions clear sleeves in 35mm and 120 roll film sizes (because of the tight folds), and Talas sleeves in 4x5-inch and larger print and sheet film sizes (the thicker and more rigid Mylar D in Talas sleeves is a distinct advantage when handling large prints).

Photofile, Inc. and some other firms[9] also supply sleeves made of matte surface "frosted" polyester, such as DuPont Mylar Type EB-11, which is claimed to minimize chances of sticking or ferrotyping. This material contains an incorporated silicon dioxide matting agent which, unfortunately, is a strong abrasive. Tests by this author show that rub-

Table 14.1 Suggested Sizes for Sleeves Made of Uncoated Polyester

Film or Print Size		Sleeve Size
35mm 4-frame strip	—	1⅝ x 6¼ inches (4.13 x 15.9 cm)
35mm 5-frame strip	—	1⅝ x 7¾ inches (4.13 x 19.7 cm)
35mm 6-frame strip*	—	1⅝ x 9¼ inches (4.13 x 23.5 cm)
120/220 3-frame strip*	—	2⅝ x 8 inches (6.7 x 20.3 cm)
4 x 5 sheet film or print (10.2 x 12.7 cm)	—	4⅛ x 5¼ inches (10.5 x 13.3 cm)
5 x 7 sheet film or print (12.7 x 17.8 cm)	—	5⅛ x 7¼ inches (13 x 18.4 cm)
8x 10 sheet film or print (20.3 x 25.4 cm)	—	8¼ x 10⅜ inches (21 x 26.4 cm)
11 x 14 sheet film or print (28 x 35.6 cm)	—	11¼ x 14⅜ inches (28.6 x 36.5 cm)
16 x 20 sheet film or print (40.6 x 50.8 cm)	—	16⅜ x 20⅜ inches (41.6 x 51.8 cm)

Note: DuPont Mylar D and ICI Melinex 516 are acceptable uncoated polyester materials. For sizes up to 4 x 5 inches, 2 to 4 mil thicknesses of polyester are suggested. For larger sizes, 4 to 6 mil thicknesses are recommended.

* Will fit in a standard No. 11 letter envelope or in a file drawer.

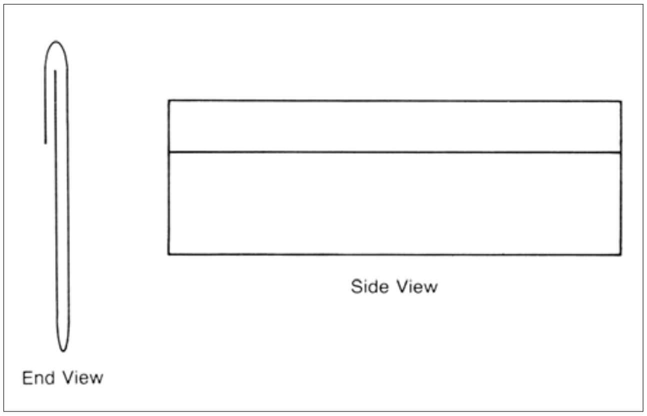
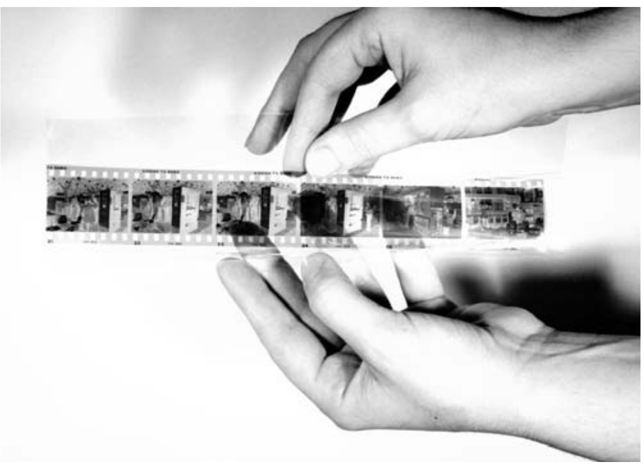


Figure 14.1 Design of a top-flap polyester sleeve. The flap folds over but is not cemented to the main body of the sleeve; this allows the sleeve to be opened like a book. To minimize the possibility of a film or print accidentally sliding out of an open end of a polyester sleeve, it is essential that such sleeves be made with tight folds.



A six-frame 35mm negative strip being inserted into a top-flap polyester sleeve made by Light Impressions Corp.

Six sleeved 35mm color or black-and-white negative strips, comprising a full 36-exposure roll, may be safely stored in a high-quality No. 11 size paper envelope, available from office supply stores.

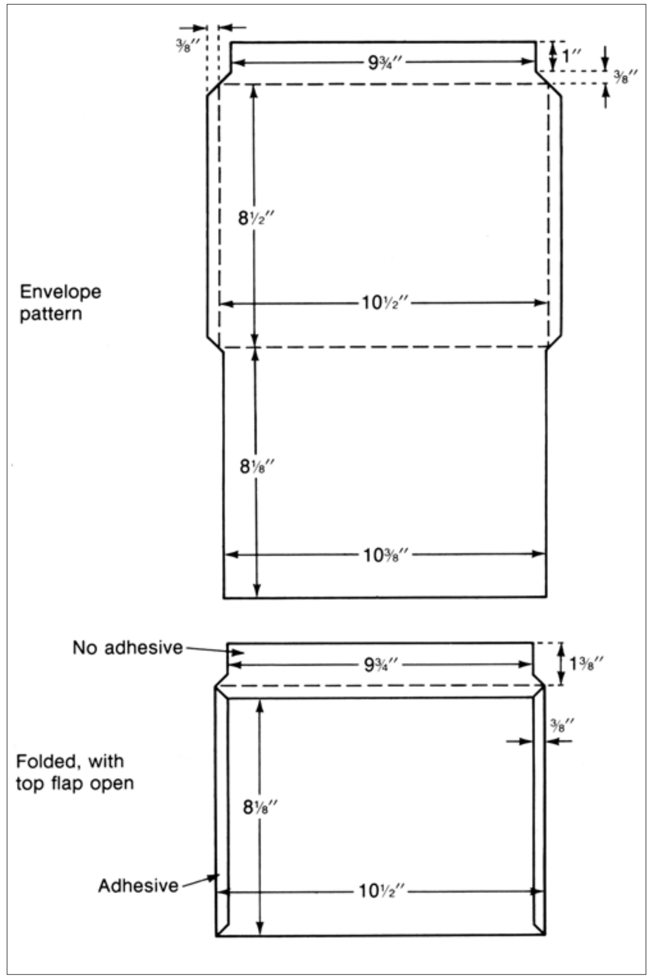


Figure 14.2 Design of a top-flap paper envelope, based on recommendations given in **ANSI IT9.2-1991**. To avoid contact between a potentially harmful glued seam and the emulsion of a film or print, this type of envelope is designed with narrow glued side seams and without a glued bottom seam.

An 8x10-inch print being placed in a heavy-gauge top-flap polyester sleeve supplied by Talas Inc.

bing the material on the emulsion of a film or print with only slight pressure will severely abrade the surface; "frosted" polyester should be avoided. For some years Light Impressions offered folders and top-flap sleeves in both clear and Mylar EB-11 matte-surface polyester; however, in 1988, the company discontinued the matte-surface products.

Polyester sleeves in either clear or matte surface and having both the top and bottom edges sealed, such as those supplied by Conservation Resources International, Inc. (sold under the Polyweld name) and Photofile, Inc. are not recommended because of the danger to films or prints of scratching during insertion and removal. The "L-sealed" polyester and polypropylene sleeves sold by Conservation Resources also are not recommended. L-sealed sleeves, which are sealed on one short side and one long side (with the other two sides open and without flaps), are, in this author's opinion, not as satisfactory as the top-flap polyester sleeves discussed previously.

Sleeves should be somewhat larger than the photographs they will contain. Fiber-base prints are particularly likely to be larger than the indicated size; for example, an "8x10-inch" print may be as large as 8¼x10⅜ inches. When fiber-base prints are dried in contact with ferrotype (glazing) sheets or ferrotyping dryer drums, the size of the print will be very close to that of the paper when it is expanded in the wet state. Contact with the ferrotype sheet prevents the print from contracting during drying, as would normally be the case.

Especially when handled frequently, large prints can be protected by inserting a sheet of high-quality 2-ply mount board behind the print in the sleeve to prevent creases and kink marks from occurring in the print. It may also be desirable to tape the top flap to the back of the sleeve after the print is inserted and the sleeve is closed; a stable, pressure-sensitive tape such as Scotch Magic Transparent Tape No. 810, made by the 3M Company, is suitable. This will prevent the sleeve from accidentally falling open during handling and is especially helpful when prints are kept in public files. For access to the print, the sleeve can be opened by cutting the tape at the joint where the edge of the flap meets the back of the sleeve.

For prints that are handled a great deal, such as in gallery print racks, an effective enclosure can be made by placing a print on a sheet of mount board cut to the proper size; a pre-cut sheet of *thin* polyester (thick polyester sheet is almost impossible to fold sharply without special equipment) which overlaps all four edges of the mount board is placed on top and the edges of the polyester are folded and adhered to the back of the mount board with a stable, pressure-sensitive tape such as Scotch Double-Coated Film Tape No. 415, made by the 3M Company. Ready-made enclosures of this type are available from Jerry Solomon Gallery Services, Inc.[10]

The polyester L-Velopes supplied by Lineco, Inc. of Holyoke, Massachusetts are also excellent for storing prints. The sleeves are sealed on two sides and have overlapping flaps on the other two sides, thus affording excellent protection from dust. Once inserted, prints are held securely in place and cannot slide out. L-Velopes are particularly useful when prints are subject to frequent handling.

Polyester sleeves are more expensive than most other types of enclosures; typical prices at the time of this writing were $0.15 for a sleeve designed to hold a 6-frame strip of 35mm film, $0.16 for a 4x5-inch sleeve, and $0.45 for an 8x10-inch sleeve. Prices are less when large quantities are purchased.

Ansel Adams adopted a system of negative storage in which a polyester folder (without a top flap) is wrapped around the negative and then placed in a paper envelope of the appropriate size; negative identification, exposure times, dodging and burning instructions, and other printing information are written on the outside of the envelope.

As yet, no manufacturer has offered a system of filing enclosures consisting of uncemented top-flap polyester (or untreated polypropylene) sleeves with matching high-quality top-flap paper envelopes of the design illustrated in **Figure 14.2**; however, it is likely that these will soon be available.[11] Sizes are needed for 6-frame strips of 35mm film (which are normally stored with six or seven 6-frame strips in one paper envelope) through 16x20 inches for both prints and films.

Cellulose Triacetate Sleeves — Not Recommended

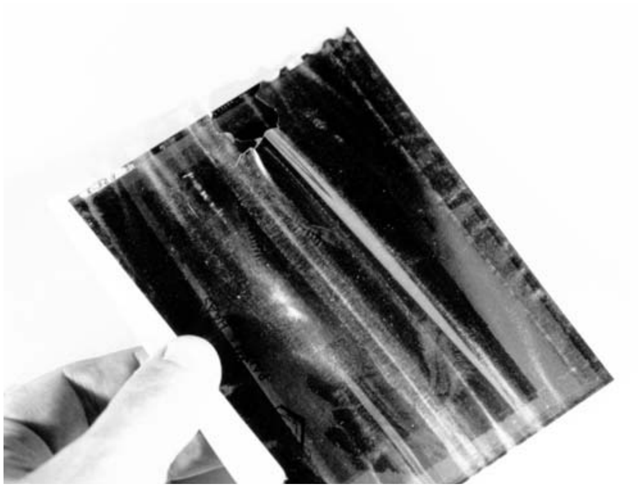
At the time of this writing, cellulose triacetate sleeves were generally available only in the cemented top- and bottom-seam sleeve design which requires that films and prints slide on the enclosure surfaces when they are inserted and removed. Unlike polyester sheets, which usually remain flat and smooth during storage, thin cellulose triacetate sheets tend to develop wrinkles, waves, and surface cockles during long-term storage. When films or prints are grouped together in files and boxes, these surface distortions may produce localized areas of relatively high pressure on the films which, in combination with sliding or "rocking" of the triacetate on the front and back surfaces of the photograph, can cause abrasion — especially if particles of dust or other dirt are present. Distorted sleeves are also more likely to cause scratches when films and prints are slid in and out. For these reasons, cellulose triacetate is distinctly inferior to polyester as an enclosure material.

At present the only commonly available cellulose triacetate sleeves are Kodak Transparent Sleeves, which are available in several sheet film sizes. They are designed to be only slightly larger than nominal sheet film sizes, presumably so that sleeved films will fit into standard sheet film boxes. Consequently, Kodak sleeves are too small to properly accommodate most paper prints of the same nominal size. Kodak introduced its Transparent Sleeves many years ago; the sleeves are comparatively expensive and appear to have only limited sales.

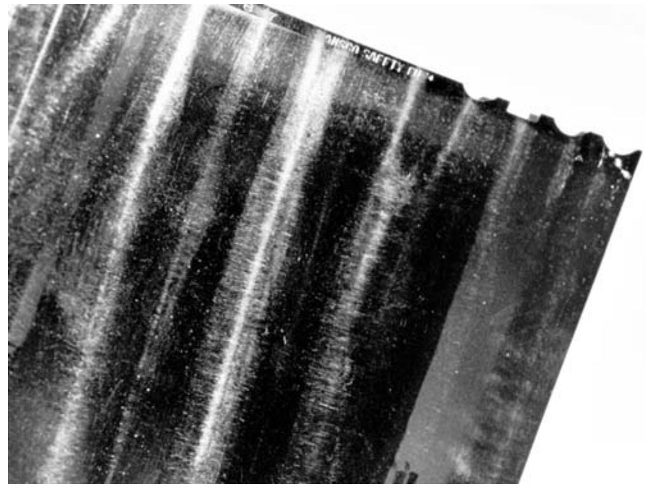
For many years, Kleer-Vu Industries, Inc. (now Kleer-Vu Plastics Corporation) produced a line of acetate sleeves which included uncemented top-flap designs for 35mm and roll films. In 1983 the firm converted most of its products to polypropylene. Both cellulose triacetate and polypropylene are less expensive than polyester.

NegaFile Systems, Inc., best known for the glassine negative envelopes the company has produced since 1939, also makes cellulose acetate sleeves in sizes 35mm (strip of 6 frames) through 4x5 inches, all in the slide-through design.

In 1984 Paterson Products Ltd. of England introduced a



Over time, sleeves made of thin cellulose acetate, such as Kodak Transparent Sleeves, tend to develop wrinkles or wave-like deformations that can eventually cause damage to film surfaces during handling and storage.



A deformed cellulose acetate sleeve caused severe localized abrasion on both sides of this 4x5-inch Ansco color transparency in the collection of the American Museum of Natural History in New York City.

line of cellulose acetate notebook-page enclosures that have been advertised as "chemically inert to ensure archival storage for correctly fixed and washed negatives." Since the pages require that negatives slide against the thin plastic surfaces of the pages during insertion and removal, however, they are not recommended.

Untreated Polypropylene Top-Flap Sleeves — Recommended

In 1983 Kleer-Vu Plastics Corporation introduced an extensive line of polypropylene sleeves and notebook-page enclosures marketed under the Pro-Line Protective Enclosures name.[12] Untreated (uncoated) polypropylene is a relatively low-cost material and appears to be the best available substitute for polyester. Untreated "oriented" polypropylene is almost as transparent as polyester. Polypropylene is considered to be a stable and safe plastic; along with uncoated polyester and cellulose acetate, it is one of the plastics recommended in *American National Standard ANSI IT9.2-1991*.[13] According to Kleer-Vu, the untreated polypropylene in Pro-Line sleeves meets the requirements of *ANSI IT9.2-1991*[14] and has been tested in contact with a few black-and-white and color photographic materials using the *ANSI IT9.2* Photographic Activity Test, with no adverse results.[15]

At the time of this writing, Kleer-Vu was supplying 35mm and other roll film sizes only in pre-cut lengths of 40 and 62 inches, which will accommodate full-roll lengths of 35mm and 120 films. The sleeves are also available in uncut 667-foot rolls. Unfortunately, short, pre-cut lengths to accommodate 35mm 6-frame strips or 3-frame strips of 120 film are not available. It is, however, a fairly simple task to cut the sleeves to short lengths with a paper cutter or scissors. Pro-Line sleeves for sheet films and prints are available in sizes ranging from 4x5 to 16x20 inches.

Kleer-Vu Pro-Line polypropylene sleeves are also supplied in cemented top-seam and glued "frosted-back" configurations. The cement in these sleeves is a "specially formulated" hot-melt adhesive, which, at the time of this writing, had not been subjected to the *ANSI IT9.2-1991* Photographic Activity Test. Translucent cellulose acetate is used for the rear sheet of Pro-Line "frosted-back" sleeves. The cemented top-seam sleeves require that films or prints slide against the plastic during insertion or removal and are therefore not recommended.

Although this author has had only limited experience with these new untreated polypropylene products, the *uncemented* top-flap sleeves appear to be suitable for long-term storage of films and prints and can tentatively be recommended as the only satisfactory alternative to the more expensive top-flap polyester sleeves. Pro-Line sleeves are only about one-sixth the cost of similar polyester sleeves. Light Impressions Corporation also supplies top-flap polypropylene sleeves in 35mm through 5x7-inch film formats under the Fold Lock name; the sleeves cost approximately one-half as much as Fold Lock polyester sleeves of the same design.

During 1984 and 1985, a number of companies converted their sleeve and notebook-page enclosure production from cellulose acetate and PVC to polypropylene, and the plastic has become the material of choice in the medium price range (polyester enclosures are the most expensive; polyethylene enclosures are the lowest in cost). Kodak and NegaFile Systems, Inc. appear to be the only major manufacturers in the United States which continue to produce cellulose triacetate sleeves (Kodak Transparent Sleeves are available only in sheet film sizes).

Top-flap polypropylene sleeves in uncut roll film sizes are currently supplied by the Filmguard Corporation of Escondido, California under the Polyguard name. Polyguard sleeves for sheet films are supplied in the top-flap design, and with cemented seams in clear and frosted-back designs. The cemented-seam sleeves are not recommended; likewise, Polyguard Econo-Matte sleeves with a polypropylene front and "frosted" PVC back should be avoided.

National Photo Products Company of Cudahy, California markets polypropylene top-flap sleeves under the

Filmguard Plastar Sleeving name. The sleeves are offered in two thicknesses, which are designated Plastar and Plastar Plus. The company also makes cemented-seam polypropylene sleeves for sheet films; these sleeves should be avoided for long-term applications.

Because Kleer-Vu identifies the manufacturer and type of polypropylene in its sleeves, this author recommends Kleer-Vu products in preference to those of other suppliers; at the time of this writing, none of the other suppliers listed in their product literature the type of polypropylene from which their sleeves were made.

Surface-Treated Polypropylene Notebook-Page Film and Print Enclosures: Not Recommended Except for Slide Pages

Polypropylene notebook-page enclosures for slides, strips of negatives, and prints are available from a number of companies including C-Line Products, Inc., 20th Century Plastics, Inc., Light Impressions Corporation, Kleer-Vu Plastics Corporation, and Franklin Distributors Corporation. These pages are all made of surface-treated polypropylene. Untreated "oriented" polypropylene cannot be satisfactorily sealed by heat or ultrasonically, which precludes its use in pocket-type notebook-page enclosures.

The surface coatings add a presently unknown element to assessing the suitability of the enclosures. The treated polypropylene may be prone to ferrotyping or sticking to film emulsions in a manner similar to that observed with polyethylene and PVC or present other problems. Indeed, this author has observed sticking of a black-and-white print emulsion to the surface of a polypropylene notebook-page enclosure made by C-Line Products, Inc., which was stored for about 2 years under normal room temperature and humidity conditions.[16] When contacted about the problem, C-Line offered to replace the enclosure at no charge and readily acknowledged that sticking has sometimes occurred with its polypropylene products:

> The problem of the photographs sticking and the diminished clarity can be traced to the same source. As the polypropylene film is processed by our supplier, they do add a surface coating. The coating acts as a "slip agent," and as an anti-static agent. Both properties are important to us, since too much, or too little coating will greatly affect how the material runs [during manufacture]. The problem you are experiencing is due to too much of the coating, causing the surface to become tacky, and the clarity to be reduced.
>
> By noting a [certain detail of the design], we were able to identify the sample sheet you sent in as a product that was run prior to September 1983. Since then, we have become more selective in the material we will accept, and our suppliers have responded to our needs.[17]

The design of notebook-page enclosures requires that negatives and prints be slid in and out. Because of this drawback — and the potential problem of sticking — polypropylene notebook-page enclosures are ***not recommended*** for long-term storage applications, except for mounted slides (see Chapter 18).

If, in spite of these problems, the decision is made to use polypropylene notebook page enclosures for negatives and prints, this author currently recommends C-Line products over those of other suppliers, especially those selling pages under their own "private label." C-Line actually manufactures its own enclosures and appears to understand the nature of the sticking problem. The company, working

Over time, surface-treated polypropylene notebook pages and sleeves may stick to print or film emulsions and are therefore not recommended for applications other than storage of mounted slides (slides have recessed mounts which minimize contact and pressure between the film and polypropylene).

In this example, a C-Line polypropylene notebook page stuck to the surface of an 8x10-inch fiber-base black-and-white print after several years of storage in a New York City apartment. The areas of adhesion can be seen clearly when light is reflected off the surface of the page. The photograph, taken by Victor Schrager in 1979, is of the late photographer Andre Kertesz and Carol Brower.

October 1991

This automatic film sleever at Linn Photo, a large wholesale photofinisher near Cedar Rapids, Iowa, used rolls of low-cost, high-density polyethylene “sleeving material” when this photograph was made in 1991 Such protective sleeving is used by most mini-labs processing color negative film and also by many large-volume photofinishing labs. High-density polyethylene sleeves are clearly superior to sleeves made of low-density polyethylene. In 1992, Linn Photo was acquired by Qualex Inc., which is a joint venture between Eastman Kodak and Fuqua Industries, Inc. Before being acquired by Qualex, Linn Photo sleeved all negatives before placing them into envelopes together with the prints for return to customers. After Qualex took over, however, sleeving was discontinued and, at the time this book went to press in 1992, the negatives were being stuffed into the envelopes with no protection, leaving them very vulnerable to fingerprints, scratches, and other damage. Qualex is the world’s largest photofinisher.

with the suppliers of its materials, has taken steps to minimize the chances of sticking, and this offers the consumer a measure of assurance that the products will be consistent from batch to batch and perform satisfactorily in the future.

Suppliers selling private label polypropylene enclosures, on the other hand, may change the source of their products without notice (usually there is no way to determine who actually made a private label enclosure) and are in a poor position to monitor the long-term performance of what they sell. When purchasing private label products, the consumer is at greater risk.

High-Density Polyethylene — the Best Low-Cost Enclosure Material

High-density polyethylene is a translucent material, somewhat similar in appearance to glassine; it does not have the transparency of polyester, polypropylene, or low-density polyethylene.

High-density polyethylene is a naturally slippery plastic, with little tendency to cling, and is normally manufactured without the antiblock and slip agents commonly used in low-density polyethylene.[18] The surface properties of high-density polyethylene and the absence of antiblock and slip agents appear to make it much less likely than low-density polyethylene to stick to or ferrotype photographic emulsions during long-term storage, especially in humid conditions. This author’s experience to date with high-density polyethylene enclosures leaves little doubt that they are superior to conventional low-density polyethylene and surface-treated polypropylene enclosures.

Of all the plastics used for photographic enclosures, high-density polyethylene appears to have the least tendency to scratch films and prints when they slide over the material during insertion and removal. High-density polyethylene enclosures have been popular for a number of years in Japan and other humid areas in Asia but have only recently become widely available in the U.S. High-density polyethylene sleeves are used by the Fuji photofinishing laboratory in Anaheim, California and by most other high-quality photofinishing companies in the U.S.

At the time this book went to press in 1992, Kodalux photofinishing labs had not yet adopted this type of negative enclosure; instead, Kodalux was returning customer negatives in an open-sided yellow paper folder.

Most currently available high-density polyethylene enclosures are made in Japan or Taiwan and consist of edge-sealed, side-by-side negative compartments with one end of each compartment open for insertion of a negative strip. “Sleeving material,” as this type of high-density polyethylene sleeve is often referred to in the photofinishing trade, is supplied in large rolls. The number of negative compartments necessary to accommodate each roll of film is cut from the sleeving roll after the negatives have been cut and inserted by machine; negative strips can also be cut with scissors and manually inserted into the sleeves. The sleeving material is available for 110, 126, and 35mm film widths in 4-, 5-, and 6-frame lengths; sleeving material for 120 film is also available.

Negatives are cut — most commonly to 4-frame lengths — and inserted into sleeves with manually operated, semi-automatic, or high-speed fully automatic machines marketed by Crown Photo Systems, Agfa-Copal, Noritsu, DOI, Labokey, and a number of other firms (see list of **Suppliers** at the end of this chapter). Cost of the machines ranges from about $500 for manually operated sleevers to more than $7,000 for high-speed, microprocessor-controlled models that automatically feed sleeving material, cut negatives to the specified frame-length, insert the strips into individual sleeve compartments, and cut the sleeving after all the negatives from a roll of film have been inserted.

High-density polyethylene sleeving in rolls is probably the least expensive of all film enclosures. For example, Noritsu America Corporation of Buena Park, California sells a 1,320-foot roll of sleeving material for about $20 with shipping additional (the minimum order is two rolls). Each roll has 6,000 negative sleeves — sufficient for more than 660 rolls of 36-exposure 35mm film cut into 4-frame lengths, for a cost of only about $0.03 per *roll* of film.

Crown Photo Systems, Inc. supplies sleeving material which is perforated between negative compartments so that they may be separated without cutting. The Crown sleeves have compartments which are about ³⁄₈-inch wider than most other sleeves and have a white stripe along one side of each compartment to accommodate written information. Crown reports that weekly sales of its sleeving material are, on average, sufficient to sleeve more than 5 million rolls of film.

Most suppliers of sleeving material offer an imprinting service for photofinishers and other large-volume users — company names, logos, promotional slogans, and other information can be printed on each sleeve.

Rolls of high-density polyethylene sleeving are not available from traditional camera stores and darkroom materials suppliers. Photographers, however, can purchase rolls of sleeving material directly from one of the suppliers listed at the end of this chapter. A photographer might, for example, want to sleeve a several-year accumulation of unsleeved color negatives which were processed by Kodalux photofinishing laboratories. When ordering rolls of sleeving, be sure to indicate the number of negative frames (4, 5, or 6 frames) that will be used with the sleeves in order to obtain the correct compartment length.

High-density polyethylene is also used for individual sleeves for negatives and prints. A major distributor in the United States is Reeves Photo Sales, Inc., which sells a variety of low-cost envelopes made of the material under the RPS Plastine Print and Film Preservers name (the same enclosures are also available from Light Impressions Corporation under the Polyethylene Thumb-Cut Envelope name). The envelopes are manufactured in Japan.

Plastine envelopes are edge-sealed on the sides and bottom, with one end open (usually with a thumb-cut to aid in removal of films or prints). The envelopes are supplied in a variety of sheet and roll film sizes, from 2¼x2¼ inches to 20x24 inches. Plastine envelope No. S-00610, which holds a 6-frame strip of 35mm film, and envelope No. S-00620, which accommodates a 4-frame strip of 120/220 film, are superior substitutes for comparable glassine envelopes used by photographers for a great many years. For storage, Plastine envelopes containing the negatives for each roll can be placed in a No. 10 or No. 11 letter envelope available from office supply stores; dates, captions, and other information can be written on the outside of the paper envelope.

Plastine high-density polyethylene envelopes are inexpensive, costing no more than most paper or glassine enclosures. For example, Plastine envelopes which hold a 6-frame strip of 35mm film cost about $45 for a box of 1,000.

Also available from Reeves is a high-density polyethylene fold-up page with attached paper wallet for 35mm and 120 films. Films and prints must be slid in and out of the enclosures. Reeves also supplies Plastine notebook page enclosures made of low-density polyethylene and slide pages made of plasticized PVC (as discussed later, neither low-density polyethylene nor PVC enclosures are recommended).

High-density polyethylene enclosures are a low-cost — and superior — substitute for common kraft paper, glassine, and low-density polyethylene enclosures, but they are not as satisfactory as top-flap polyester or untreated polypropylene sleeves.

At the time of this writing, this author has insufficient accelerated test data and user experience with high-density polyethylene sleeving material to be able to recommend a particular brand. For the reasons discussed below, however, *low-density* polyethylene sleeving material should be avoided. A few suppliers, including NegaFile Systems, Inc., market sleeving material made of low-density polyethylene.

Low-Density Polyethylene Enclosures — Not Recommended

Low-density polyethylene enclosures first came into widespread use in the U.S. in the mid-1960's with the introduction of Print File Archival Preservers, originated by Print File, Inc. of Schenectady, New York, and now manufactured by Print File, Inc. of Orlando, Florida (a separate company which up until the end of 1987 called itself Photo Plastic Products, Inc. — the Print File, Inc. located in Schenectady is still in operation as one of the many distributors of the enclosures). Low-density polyethylene enclosures are also made by several other companies, including Vue-All, Inc. of Ocala, Florida.

The most common types of low-density polyethylene enclosures are notebook pages designed to contain an entire roll of film cut into strips. Low-density polyethylene is sufficiently transparent to permit contact prints to be made without removing the negatives from the enclosure; however, there is a significant loss of image sharpness of contact prints made in this manner because of light scatter in the semi-transparent polyethylene.

The very low cost of low-density polyethylene (it is the least expensive of all plastics — the primary reason it is used to make garbage bags) and the ease with which it can be heat sealed into multi-compartment enclosures have contributed to the popularity of low-density polyethylene products. However, this author's personal experience and reports received from many users of Print File and similar low-density polyethylene enclosures over the past several years have indicated a serious problem with negative scratches caused by these enclosures. Films must be slid in and out of the enclosures, and small particles of dirt sandwiched between the film and the polyethylene can cause scratches. The problem appears to be most serious with 35mm films, the majority of which do not have gelatin anti-curl backings. In addition, this author has observed negatives ferrotyping and sticking to Print File enclosures after several years of storage in typical storage environments. A reader of *Camera 35* magazine wrote:

> Five years ago I changed from glassine envelopes to polyethylene preserver pages which fit into three-ring binders. Now I've discovered those early negative strips have become *laminated* to the preserver page — despite storage in a constant temp/humidity environment.
>
> On further examination, I've also found that film will be scratched on the acetate side from a single insertion into a previously unused sleeved preserver page.[19]

A close-up view of a Print File low-density polyethylene notebook-page enclosure. Areas of adhesion between a Kodak Tri-X negative and the polyethylene enclosure are clearly evident. This type of adhesion, often referred to as ferrotyping, is most likely to occur in humid environments.

With the negative removed from its sleeve, damage in the form of irregular gloss on the emulsion surface is clearly visible. The sticking occurred after about 5 years of storage under normal conditions in this author's house in Grinnell, Iowa.

There is little in the published literature that suggests *pure* polyethylene could chemically harm photographs stored in the dark; polyethylene, along with polyester, polypropylene, and cellulose triacetate, is one of the plastics recommended in *ANSI IT9.2-1991*. RC (polyethylene-resin-coated) prints are made with a paper core coated on both sides with polyethylene using a hot extrusion process. The manufacture of RC paper has given the photographic industry considerable experience with the stability characteristics of polyethylene and the effects it could have on silver and dye images during long-term aging.

Low-density polyethylene is a naturally flexible material and like polyester does not require the addition of plasticizers to impart flexibility. In practice, however, a number of additives are usually incorporated into the basic polyethylene resin to improve processing and handling characteristics. These include antioxidants, UV stabilizers, antiblock agents, slip agents, pigments, flame retardants, and antistatic additives.

Antiblock agents prevent sheets of polyethylene from sticking together during manufacture and use. Untreated polyethylene sheets have a tendency to "grab" or stick together in the manner that food wraps such as Saran Wrap do. Fine-particle silicas are often used as antiblock agents. Lubricants known as slip agents are added to improve handling in fabrication machinery; slip agents may also serve to reduce blocking and static electricity. Slip agents are incorporated into polyethylene resin during manufacture and migrate to the surface after extrusion, forming a thin, invisible layer that lowers the coefficient of friction. As applied to low-density polyethylene, the term "uncoated" is probably meaningless. This author is not aware of any published research on the long-term physical and chemical effects of the many additives in low-density polyethylene on color and black-and-white photographs.

There have, however, been reports that polyethylene containing BHT (butylated hydroxytoluene), an antioxidant commonly present in polyethylene, has caused white fabrics wrapped in polyethylene to yellow during dark storage.[20] The yellowing has been attributed to a complex reaction involving BHT, moisture, and nitrogen dioxide (a common air pollutant) or other oxides of nitrogen. BHT can diffuse out of polyethylene and be absorbed by adjacent materials. What implications this has for photographic films and prints stored for long periods in polyethylene enclosures is not clear, but it is cause for concern.

The sticking observed with films and prints stored in low-density polyethylene enclosures is probably related to the presence of antiblock and slip agents incorporated in polyethylene during manufacture. The matter is further complicated by the variety of additives employed by the resin manufacturers; polyethylene is made in a vast number of types and grades by manufacturers in many countries. Pigments or other coloring materials added to the nontransparent grades may also have adverse effects on photographs. This author contacted several manufacturers of low-density polyethylene photographic enclosures; none indicated that testing had been done to determine if there are any harmful reactions — or sticking — of their products with common photographic materials, as determined by the *ANSI IT9.2-1991* Photographic Activity Test.

In a 1978 study undertaken by the Public Archives of Canada (renamed the National Archives of Canada in 1987), low-density polyethylene enclosures subjected to the *ANSI PH1.53* Photographic Activity Test adhered to black-and-white film emulsions and became so tightly bonded to most of the print materials tested that the emulsions separated from the paper base when the polyethylene enclosure material was pulled off. The applicability of this test for plastic enclosure materials has been questioned, however, as the 122°F (50°C) temperature and 86% relative humidity test conditions could produce ferrotyping and adhesion that would not occur under more moderate conditions.

Nevertheless, experience over the past 10 years indicates that even under normal conditions, low-density polyethylene enclosures have a pronounced tendency to stick to emulsions or cause ferrotyping of the emulsion surface; this problem has not been observed with films and prints stored in polyester and cellulose triacetate enclosures under the same moderate temperature and humidity conditions. This author has also noted that print emulsions in contact with low-density polyethylene for only a few months under normal storage conditions absorb unidentified substances from the polyethylene which causes India ink (such as Koh-I-Noor 3080-F Universal Waterproof Black India Ink) to form beads on the print surface and resist absorption into the emulsion.

Because of sticking and numerous other problems observed with these products — and the many unanswered questions concerning their long-term suitability — low-density polyethylene enclosures are not recommended.

Polyvinyl Chloride (PVC) Enclosures — Not Recommended

Storage of photographs in either plasticized, low-plasticized, or nonplasticized polyvinyl chloride (PVC) is specifically advised against by American National Standard *ANSI IT9.2-1991*.[21] Kodak, Ilford, and Polaroid have also advised that PVC enclosures be avoided.[22,23,24] (It should be noted that despite Kodak's often-repeated recommendations to avoid PVC, since 1983 the company has supplied plasticized PVC print and negative wallets with its Kodalux "premium" Magnaprint 35 Service for oversize 4x6-inch prints. Polaroid has also sold print albums with pages made of plasticized PVC.)

Plasticized PVC has proven to be particularly harmful; it can contaminate, stick to, and even destroy films and prints. Problems are especially severe in humid storage conditions. To make PVC flexible, plasticizers, usually organic compounds, are added in large amounts (40 to 100 parts plasticizer per 100 parts PVC). Particularly when stored in high-humidity conditions, the plasticizers can gradually exude from the PVC, depositing sticky droplets or gooey coatings on photographs. Some types of plasticizers migrate more readily than others; high-humidity conditions appear to greatly increase exudation of the plasticizers. PVC plasticizers can support fungus growth in humid conditions, thereby causing additional damage to stored photographs. (Even under low-humidity conditions, the plasticizers in flexible PVC will cause softening, sticking, and partial transfer of electrostatic copier images, such as those made on Xerox machines.)

Plasticizers commonly used in the manufacture of PVC have a distinct odor, and the plasticizer content of many flexible PVC enclosures is so great that most people can easily smell fumes given off by the material when it is held a few inches from the nose. In addition to the plasticizers that make PVC flexible, antiblock agents, antistatic agents, stabilizers, and other additives are also commonly added to PVC during manufacture.

In a 1985 study of photographic enclosures materials, R. Scott Williams, a conservation scientist at the Canadian Conservation Institute, reported:

> I have examined two cases where slides were damaged by storage in phthalate plasticized poly(vinyl chloride) enclosures. In the first case, oily droplets were formed on slides. These were identified as phthalate plasticizers identical to those contained in the poly(vinyl chloride) enclosures. When projected, the droplets on the slide are visible as disfiguring spots on the image.
>
> In the second case, a waxy film formed on slides with protective glass covers. Only slides with glass covers show this phenomenon. Unglassed slides in the same enclosure do not have the waxy film. Analysis of the waxy film showed it to be composed of carboxylate salts of the type used as lubricants or more commonly as heat stabilizers in poly(vinyl chloride), and that these components were also found in the PVC of the enclosure.
>
> In addition, there is the further, often cited, disturbing possibility that the PVC may degrade to produce acidic hydrogen chloride gas. It is to prevent this degradation that PVC must be highly compounded with additives to inhibit these reactions or to scavenge degradation products before they escape from the plastic.[25]

Flexible PVC is commonly used to make notebook-page enclosures with individual pockets for mounted transparencies. Some of these pages have a "frosted" PVC backing sheet to provide diffused light for viewing the transparencies. The front sides of the pages are usually glass-clear. The pages are normally made of a fairly thick PVC material to maintain rigidity in a notebook.

Beginning in 1977 and running through 1982, a number of articles and letters concerned with the pros and cons of PVC slide pages appeared in *Modern Photography* magazine. It started with a August 1977 column by *Modern* writer Ed Scully:

> All of the conferences [on preservation] I've attended have come to the same conclusion — if the sheet you store your slides or prints in stinks, don't use it. If you insist on handsome products for storing your slides, you will probably get stuck with one of the smelly polyvinyl chlorides that are poison for your color slides or prints.[26]

That brought an angry reply from Robert D. Shipp, president of 20th Century Plastics, Inc., a Los Angeles, California firm which is probably the largest supplier of PVC slide pages in the United States (20th Century Plastics has since introduced an extensive line of polypropylene slide pages). In a letter to the magazine, Shipp complained:

> . . . we feel that Mr. Scully has set forth in a most irresponsible manner false statements concerning such [PVC] products without any basis in fact nor without any empirical or scientific evaluation or collaboration.
>
> Mr. Scully's article has caused irreparable harm and injury to our company and its reputation and to others like us in the industry. Unless you have proof of the harmful nature of *all*

> Polyvinyl Chloride materials, we demand an immediate retraction by Mr. Scully of his editorial article. . . .[27]

In its defense the magazine cited a list of literature references (including *ANSI PH1.43-1971*) which advised against the use of PVC, and concluded:

> It seems to *Modern* that the experts agree that PVC in general theory should be avoided . . . but that 20th Century Plastics has made tests in particular during which time no deleterious effects were noted. (And being practical about it, we searched for, but could not find, a single report anywhere in the world of damage to films, slides or prints caused by PVC.) The choice to use or not use any specific product, as always, thus remains with the purchaser. If and when there is additional information on PVC, pro or con, *Modern* will publish it.

A few months later, in 1980, Paul A. Elias, wrote a letter to *Modern* saying:

> Now that the Great Yellow Father [Eastman Kodak Company] has confirmed what we chemists have been saying for the last several years — that polyvinyl chloride can and does damage slides — how about dropping 20th Century Plastics from your list of advertisers? Do you still need to see dead bodies, or do you now believe because God [Eastman Kodak] said so?[28]

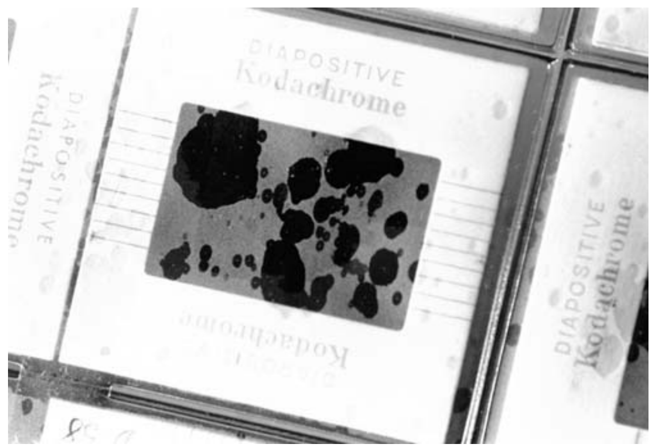
To which the magazine replied:

> Yes, indeed, Mr. Elias, Eastman Kodak's film experts have indicated that they do not recommend polyvinyl chloride sheets for storing transparencies. However, they have not *confirmed* anything! Before we take the stern measures you suggest, it is our considered opinion that we *do* need the "smoking gun" and so far, it hasn't materialized. In short we have yet to see a single set or even one transparency with damage claimed to be from PVC slide storage sheets, and until we do our advertising policy will not be changed.

In August 1981, Herbert Keppler, at the time the editorial director and publisher of *Modern Photography,* finally had the proof that the magazine was looking for:

> While I do not believe for an instant that all PVC pages will harm all slides, I now have what chemists feel is proof positive that some PVC slide storage pages sent me by readers have caused damaged to the slides therein, just as Kodak described. It can and does happen. It would appear that the plasticizer in PVC which contributes to the pages' flexibility, has a tendency to leach out, particularly with humidity, and can damage the slides.

A plasticized PVC slide page in which gooey plasticizer has exuded onto the surface of Kodachrome slides. This page was discovered in the collection of Magnum Photos, Inc.'s New York City office in 1983, before the agency moved and upgraded its facility.



When viewed in light reflected off the surface of the slide page, the slimy droplets of plasticizer on the film and mount surfaces are readily apparent.

1983

When a slide is removed from the page, image-damaging deposits of gooey plasticizer remain adhered to the film surfaces. Disposable gloves should be worn when removing slides from deteriorated pages to avoid getting plasticizer on one's hands.

> A number of PVC page makers have had so-called accelerated scientific tests run by allegedly independent labs proposing to show no slide damage caused by PVC. Few, if any, ran them under humid conditions — and accelerated tests, I feel, are questionable — particularly when paid for by the very ones who hope to be exonerated.[29]

This author's experience with plasticized PVC points to the same conclusion reached by Keppler: namely, that the exudation of plasticizers is the primary problem of flexible PVC, and that high-humidity conditions tend to exacerbate the situation.

In 1983, 20th Century Plastics, Inc. added a number of "archival" polypropylene notebook-page enclosures to its line of products — the pages are sold under the EZ2C Super-heavyweight, EZ2C Heavyweight, and Century-Poly names. At the time of this writing, however, many 20th Century Plastics products continue to be made of plasticized PVC (and the company continued to advertise in *Modern Photography* until the magazine ceased publication and sold its subscription list to *Popular Photography* in 1990).

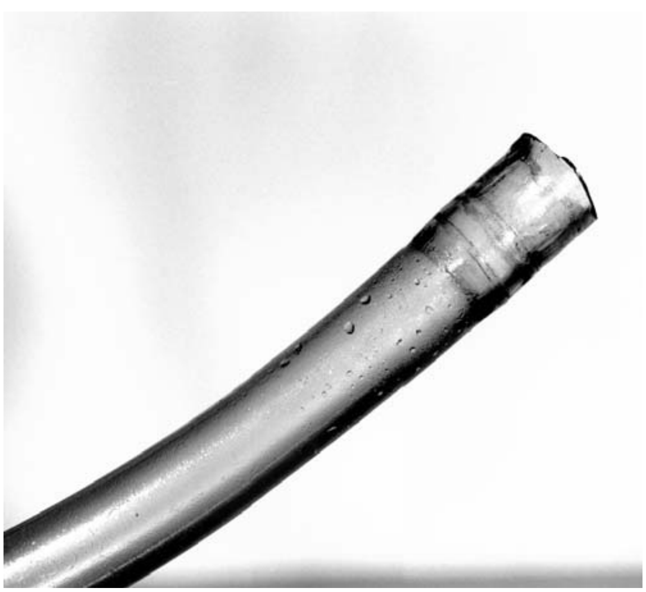
Also available from 20th Century Plastics and a number of other manufacturers are plasticized PVC enclosures designed to contain negatives, color transparency strips, and prints. They are of similar design to the previously described polyethylene enclosures and permit viewing of the photograph or direct contact printing of negatives through the enclosure (polyethylene enclosures are usually of a thinner gauge and are somewhat milky in appearance; the PVC enclosures are glass-clear).

Practical aspects of slide pages and slide storage systems are discussed in Chapter 18. Chapter 18 also includes a listing of suppliers of polypropylene slide pages — the only type of slide page recommended by this author. (The 20th Century Plastics EZ2C Super-heavyweight page is this author's primary recommendation for slide pages.)

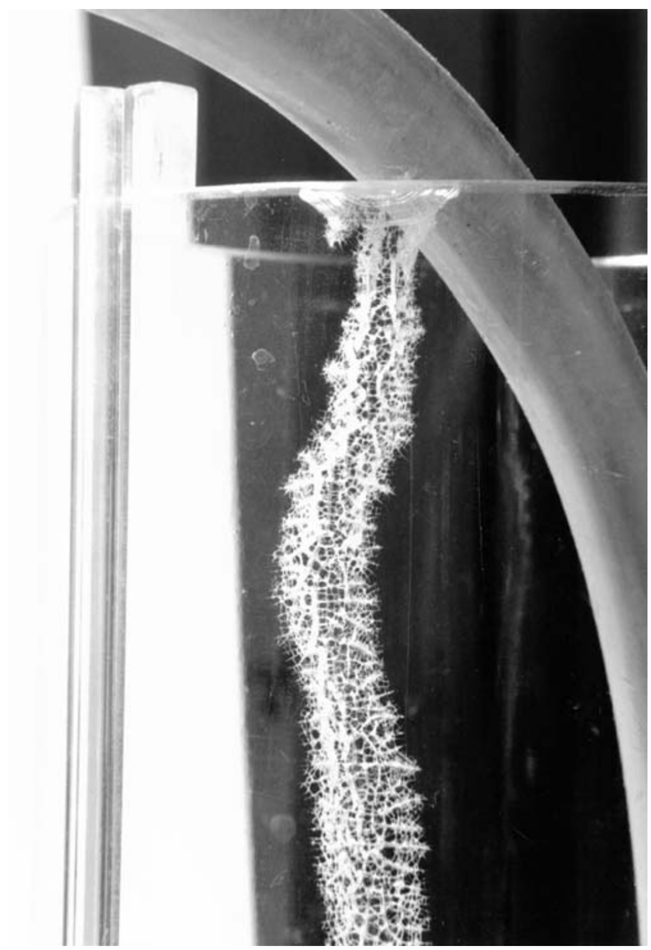
DuPont Tyvek — More Testing Needed

Tyvek is a synthetic material made of very thin high-density polyethylene fibers bonded under heat and pressure to make an opaque paper-like sheet. Tyvek and similar materials have been used extensively for high-strength mailing envelopes, protective storage jackets for computer floppy disks, and many other products; for a given weight and thickness, Tyvek is much stronger and tear-resistant than paper. With use, paper appears to generate significantly more dust (composed of bits of paper fiber) than does Tyvek.

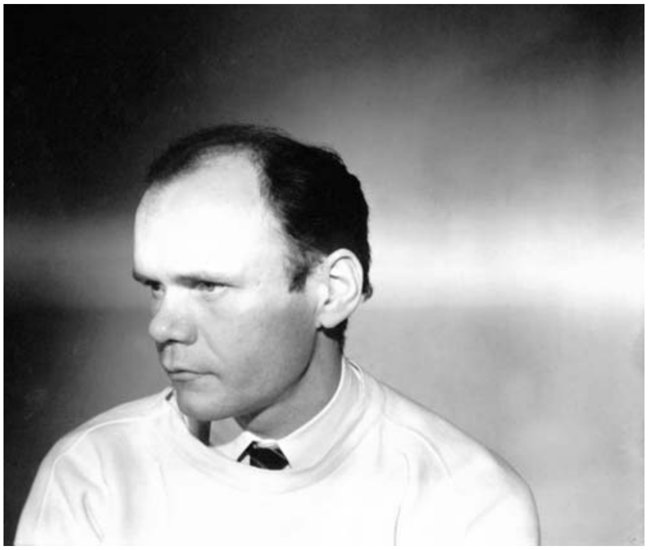
In 1972 W. F. van Altena, who at the time was working at the Yerkes Observatory in Williams Bay, Wisconsin, studied the various paper and plastic enclosure materials then being used to store astronomical glass plates. He found problems with all of them but after some investigation, recommended that the most suitable material for such en-



Exudations of plasticizer are not restricted to PVC slide pages, but can occur with many types of heavily plasticized PVC. After about 15 years of storage in this author's darkroom, this PVC hose began to drip plasticizer onto an acrylic plastic film washer.



Oozing down the inside of the film washer column, the plasticizer caused severe surface cracking (crazing) of the acrylic plastic.



© Barbara Morgan

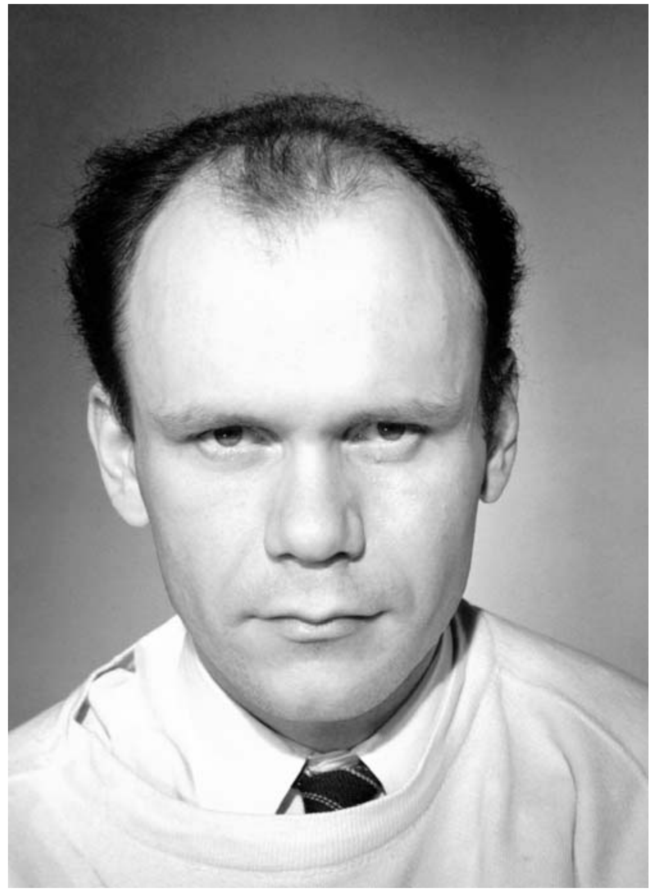
A recent contact print of a 4x5-inch negative made in 1942 that was damaged by being stored in a kraft paper envelope. The portrait, by Barbara Morgan, is of photography historian Beaumont Newhall. Then age 33, Newhall was director of the Department of Photography at the Museum of Modern Art in New York City. The negative was stored for more than 30 years with the emulsion side resting against the glued seam in the center of the envelope. This caused a yellowish stain in the area that was in contact with the seam; when printed, the stain resulted in the light (minus-density) band running through the center of the image. Damage of this type also has been caused by glued seams in glassine envelopes.

velopes was Tyvek.[30] The material can be written on with ballpoint pens, but not with pencils. According to van Altena, Kodak conducted accelerated aging studies with Tyvek in contact with several types of processed color films for 14 and 28 days at 140°F (60°C) and 70% RH, and concluded that the material had no effect on the dye stability of the test films. No tests with silver-gelatin black-and-white materials were reported. Van Altena suggested use of Paisley adhesive No. 47-SU291, a polyvinyl acetate adhesive, for cementing the seams of the envelopes. Tyvek envelopes are now in use at several observatories; however, as yet they are not commercially available in normal roll film and sheet film sizes.

The soft surface of Tyvek appears to minimize the likelihood of scratches when prints and negatives slide against it. Upon further testing of both Tyvek and adhesives for cementing it, the material may prove to be a satisfactory substitute for high-quality paper envelopes for storing photographs. However, until the results of testing of specific, identified grades of Tyvek and suitable adhesives are published, this author suggests that Tyvek enclosures be avoided.

Paper and Glassine Enclosures — Most Are Unsatisfactory

Until the late 1970's, when plastic photographic enclosures became popular, most envelopes and sleeves were made of glassine or brown kraft paper with the seams cemented with various types of adhesives. These materials



© Barbara Morgan

A print from another negative made at the same time and stored in an identical envelope. In this case, the negative was not harmed because the emulsion faced **away** from the glued seam. The negatives had been stored in Morgan's home outside New York City. As in most homes, during the summer months the relative humidity frequently was high; had the negatives been stored in a constant, low relative humidity environment, damage probably would not have occurred. A significant number of Morgan's negatives, including some of her well-known photographs of dancer and choreographer Martha Graham, were damaged by storage in kraft paper envelopes. (Courtesy Barbara Morgan)

are generally unsuitable for long-term storage of photographs, and most older collections have examples of damage caused by glassine or kraft paper enclosures. Glassine is specifically advised against by *ANSI IT9.2-1991* and by Eastman Kodak.[31] So-called "acid-free" alkaline-buffered glassine should also be avoided. The most satisfactory low-cost substitutes for glassine envelopes are high-density polyethylene enclosures, which have been discussed previously.

Particular problems have been noted with paper and glassine envelopes which have a cemented seam in the center. The adhesive, which is often hygroscopic, can cause staining and fading of photographs, especially in humid storage conditions. Because the overlapped seam is two pieces of paper thick, added pressure is placed on the photograph in the seam area when the enclosures are stacked

1987

James Wallace, Jr., director and curator of Photographic Services at the Smithsonian Institution in Washington, D.C., is shown in the Photographic Services' cold storage vault. Older negatives stored in the vault have been removed from their original enclosures and placed in polyester sleeves, which in turn have been put in high-quality paper envelopes.

1987

To speed the resleeving project and also to retain all inscriptions and markings on the original negative envelopes, a Canon office copier that could accommodate 4x5-inch and larger negative envelopes was obtained, and the old envelopes were copied onto the new ones.

or placed tightly in boxes. The localized pressure aggravates problems with the adhesive. Negatives filed in this type of enclosure should have the base side of the film next to the seam to avoid emulsion contact with the adhesive area. Old collections should be examined and the negatives reoriented if necessary so that none of the film emulsions are in contact with the cemented seam. Keeping the relative humidity in the storage area between 25% and 40% will considerably slow deterioration.

ANSI IT9.2-1991 says the following about adhesives:

> If an adhesive is used, it shall have no harmful effect on the photographic images. The adhesive shall be applied to Whatman Number 1 filter paper and shall pass the photographic activity test outlined in 5.1. . . . Some photographic images can be damaged by adhesives incorporating impurities such as sulfur, iron, copper, or other ingredients that might attack image silver, gelatin, or the paper support of prints. Various adhesives are hygroscopic, thus increasing the possibility of local chemical activity. Pressure-sensitive and ether-linked products should be avoided.
>
> Avoid using rubber-base products such as rubber cement. Not only might they contain harmful solvents or plasticizers, but they might be compounded with photographically damaging sulfur, usually a vulcanizer, accelerator, or stabilizer. Even some "low-desensitizing" or "sulfur-free" rubbers contain sulfur.
>
> If a particular brand of commercially made adhesive is found to be safe for long-term storage purposes, there is no assurance that subsequent batches will contain ingredients of the same purity.[32]

The low-quality paper and glassine with which many enclosures are made can be very damaging to prints and films in long-term storage, especially in humid conditions. Eugene Ostroff of the Smithsonian Institution in Washington, D.C. has described some of the problems:

> The brown kraft negative envelopes traditionally used for storing negatives contain image-damaging ingredients, such as lignin, which generate destructive peroxides. (As we have all observed, kraft envelopes quickly become brittle and disintegrate.) Glassine paper, more fragile than kraft, is made from "hydrated" fibers that enhance translucency and flexing properties, characteristics that are heightened with plasticizers and other additives. Many of these ingredients are impermanent (they volatilize or leach out); the paper becomes brittle and falls apart at the slightest touch. Aside from damaging the image, these degenerative byproducts also might destroy all cataloging information written on the envelopes. Consequently, additional labor costs are incurred by making new entries, refiling, and cleaning debris from the cabinet.[33]

1987

Barbara Whitted, a technician at the NASA Film Repository at the Lyndon B. Johnson Space Center in Houston, Texas, removes negatives and transparencies from their original glassine and acetate sleeves and places the films into new polyester sleeves, which are then inserted into protective paper envelopes. With Whitted is Gary Seloff, curator of visual resources at the Johnson Space Center. The resleeving project involved more than 600,000 items.

James McCord, chief of the photographic laboratories at the Earth Resources Observation Systems (EROS) Data Center in Sioux Falls, South Dakota, reported in 1979 that cemented seams on glassine envelopes caused localized yellow dye loss on Kodak Ektachrome Duplicating Film Type 2447; the yellow dye fading could in some cases be detected in as little as 90 days and was frequently observed within 6 months.[34] After the problem was detected, the EROS Data Center discarded all the glassine envelopes in its collection and replaced them with paper and Tyvek envelopes.

In 1987, the National Aeronautics and Space Administration (NASA) began a massive project to resleeve the more than 600,000 still photographs that were being stored in glassine and cellulose triacetate enclosures in the collection of color and black-and-white photographs stored at the NASA Film Repository at the Lyndon B. Johnson Space Center in Houston, Texas. On the advice of Noel Lamar, a consultant working for NASA, polyester folders (without a top-flap), placed in high-stability alkaline-buffered paper envelopes, were adopted for the resleeving project (this is the same method of storage that was used by the late Ansel Adams for his negatives).

General requirements for paper suitable for photographic filing enclosures are discussed in Chapter 13. When a paper envelope is made with glued seams, the adhesive must be acceptable when tested by the *ANSI IT9.2-1991* Photographic Activity Test with every type of black-and-white and color material that is to be stored in it. The reader is also referred to Chapter 13 for a discussion of accelerated tests for paper enclosures, mount boards, and adhesives to be used with black-and-white and color films and prints.

A paper envelope based on the design suggested in *ANSI IT9.2-1991* is shown in **Figure 14.2**. Only two narrow glued seams are needed — one on each side. The seams are non-overlapping, and an ungummed top-flap is provided to keep out dust and dirt. Because a photograph in an envelope usually rests against the bottom, the bottom is folded to avoid a glued seam. This design results in a smooth interior and provides three uniform thicknesses of paper on the top and both sides, thereby promoting even stacking and minimizing localized pressure on the enclosed film or print. A nonreactive and nonhygroscopic cement is essential for connecting the seam-flaps to the outside of the envelope; polyvinyl acetate (PVA) adhesives have been recommended by Kodak.[35] Ideally, this envelope would be used in combination with top-flap polyester sleeves. At the time of this writing, high-quality envelopes of the ANSI-suggested design and made with tested papers and adhesives were not yet commercially available.

Encapsulation of Photographs — Sometimes Useful

Photographs may be placed between two polyester sheets which are joined to each other on the edges with special double-sided pressure-sensitive tapes (3M Scotch Double-Coated Film Tape No. 415 is usually recommended for this purpose).[36] The photograph itself is not in contact with the double-sided tape and can readily be removed by cutting open one edge of the encapsulation. This technique can be particularly effective if the photograph is fragile. Some concern has been expressed about the possibility of lateral migration of the adhesive beyond the edges of the double-sided tape; over time the adhesive might contact the edge of the encapsulated print. Encapsulation has been used extensively at the Library of Congress and other institutions (for detailed instructions on how to encapsulate photographs and documents, refer to *Polyester Film Encapsulation,* published by the Library of Congress[37]).

As an alternative to double-sided pressure-sensitive tape, Jane Booth of the San Diego Historical Society has a method by which she sews two sheets of polyester together with nylon thread on an ordinary sewing machine.[38] The stitching enables her to quickly make enclosures that are tailored to the size and proportions of individual prints and to the requirements of her files. It is also possible to make enclosures with multiple compartments for storage of a number of smaller prints. In addition, potential problems with pressure-sensitive tapes are avoided.

Institutions which encapsulate photographs or fabricate other types of polyester enclosures on a large scale will find an electrically operated sealing machine, such as the Polyweld Model B-50 device sold by Conservation Resources International, Inc., to be very convenient.

Notes and References

1. Seams of cellulose triacetate sleeves can be cemented with a solvent such as methylene chloride or a cement composed of cellulose triacetate dissolved in methylene chloride or other suitable solvent. Kodak Transparent Sleeves, made of cellulose triacetate, have cemented top and bottom seams. Solvent bonding is probably harmless to photographs kept in such enclosures and avoids the sorts of problems encountered with the glues used in many paper and glassine envelopes.
2. Suitable papers include Atlantis Silversafe Photostore (a 100% cotton fiber paper) and Archivart Photographic Storage Paper, both supplied in the U.S. by Archivart Division of Heller & Usdan, Inc., 7 Caesar Place, Moonachie, New Jersey 07074; telephone: 201-804-8986; toll-free: 800-333-4466. Silversafe Photostore is made by the Atlantis Paper Company, Ltd., No. 2 St. Andrews Way, London E3 3PA, England; telephone: 011-44-71-537-2727. Also believed to be satisfactory is Renaissance Paper, a paper intended for photographic storage applications and supplied by Light Impressions Corporation. All of these papers are nonbuffered and have a near-neutral pH at the time of manufacture. See Chapter 13 for further discussion.
3. Eastman Kodak Company, **Preservation of Photographs,** Kodak Publication No. F-30, Eastman Kodak Company, Rochester, New York, August 1979, p. 31.
4. "Oakland Fire Results in New Storage Ideas," **Newsletter of the Friends of Photography,** Vol. 5, No. 12, December 1982.
5. Thomas O. Taylor, "Identification and Use of Plastic Materials for Photographic Storage," presentation at the American Institute for Conservation Photographic Materials Group Winter Meeting, Philadelphia, Pennsylvania, February 2, 1985.
6. Sleeves should be made of **uncoated** polyester, such as DuPont Mylar D or ICI Melinex 516. Polyester sheet is sold with a wide variety of surface coatings which allow it to be cemented, heat-sealed, or to accept printing inks and dyes or other treatments. Some coatings give the sheets antistatic properties. Many of these coatings are hygroscopic, creating a high surface-moisture level. These coatings may cause the sleeves to stick to each other or to photographs stored in them and may produce chemical damage to photographic images. Sleeves ordered by this author in 1974 were made of a coated polyester — even though uncoated Mylar polyester was specified. The fact that the polyester was coated became apparent when the sleeves started firmly sticking to themselves during storage in this author's darkroom. Fortunately, the problem was discovered before any of the negatives stored in the sleeves were damaged. Mylar D or a similar uncoated polyester film must be specified, and the importance of using an uncoated product should be stressed when purchasing polyester sheet material or when having sleeves made by custom plastics fabricators.

   If it is necessary to have sleeves specially made, emphasize to the fabricator the need for **tight** folds so that the film or print will not have a tendency to slip out of the sleeve during handling. Sleeves made for glass plates should have folds of a much larger radius to properly accommodate the relatively thick plates; these sleeves should not be used for films or prints. A number of plastics fabricators can make sleeves of this type on special order. One firm which has advertised that it is willing to handle small orders for special designs of Mylar D polyester enclosures is the Taylor Made Company, P.O. Box 406, Lima, Pennsylvania 19037; telephone: 215-459-3099.

   See also: "A Clear Connection with the Past," **DuPont Magazine,** Vol. 76, No. 6, November–December 1982, pp. 10–11.
7. P. Z. Adelstein and J. L. McCrea, "Stability of Processed Polyester Base Photographic Films," **Journal of Applied Photographic Engineering,** Vol. 7, No. 6, December 1981, pp. 160–167.
8. W. J. Barrow, "Migration of Impurities in Paper," **Archivum**, Vol. 3, 1953, pp. 105–108.
9. Photofile, Inc. and the Hollinger Corporation, among others, sell polyester sleeves, made with DuPont Mylar Type EB-11 or similar products, which contain a silicon dioxide matting agent. These sleeves are highly abrasive and should be avoided. For a number of years Light Impressions Corporation also sold Mylar Type EB-11 sleeves and folders; the company discontinued EB-11 sleeves in 1988.
10. Pre-made enclosures of this type, with an open top, are available from Jerry Solomon Gallery Services, Inc., 960 North La Brea Avenue, Los Angeles, California 90038; telephone: 213-651-1950; toll-free 800-821-5948. The firm will custom make the design described by this author; a minimum order of 25 enclosures is requested.
11. Light Impressions Corporation supplies a matched set of polyester sleeves, polyester folders, and paper envelopes under the NegaGuard name. However, the envelopes are of an open-top design which allows dust to enter. The basic idea behind the NegaGuard system is sound and it is hoped that the envelopes will be improved.
12. Probably the first supplier of polypropylene photographic enclosures was C-Line Products, Inc. The firm produces surface-treated (coated) polypropylene notebook pages for mounted slides, negatives, and prints in various formats. Certain C-Line products have been sold under private labels by Light Impressions Corporation, Kleer-Vu Plastics Corporation, and others. Kleer-Vu Plastics fabricates its own polypropylene print and film enclosures; C-Line has made Kleer-Vu's slide pages. Polypropylene notebook-page enclosures are not recommended for other than mounted slides.

    Sleeves made of polypropylene and designed to accommodate stereo views and carte-de-visite photographs are available from Russell Norton Photographic Antiques, P.O. Box 1070, New Haven, Connecticut 06504-1070; telephone: 203-562-7800.
13. American National Standards Institute, Inc., **ANSI IT9.2-1991, American National Standard for Imaging Media — Photographic Processed Films, Plates, and Papers — Filing Enclosures and Containers for Storage**. (This Standard, which replaced **ANSI PH1.53-1986**, includes a new version of the Photographic Activity Test which is based on work done by James M. Reilly and Douglas W. Nishimura at the Image Permanence Institute at the Rochester Institute of Technology in Rochester, New York.) American National Standards Institute, Inc., 11 West 42nd Street, New York, New York 10036; telephone: 212-642-4900; Fax: 212-302-1286. See also: American National Standards Institute, Inc., **ANSI PH1.45-1981, American National Standard Practice for Storage of Processed Photographic Plates,** Sec. 3.3, p. 7.
14. American National Standards Institute, Inc., see Note No. 13. The Photographic Activity Test described in the Standard is a relatively simple test which, because of the combination of the elevated temperature and high relative humidity employed, may not be appropriate for the evaluation of plastic storage materials.
15. Lisa Overton, Kleer-Vu Plastics Corporation, telephone discussion with this author, August 31, 1983. When introduced in 1983, Pro-Line sleeves were sold under the Poly-Pro name. The polypropylene sheet used to make Kleer-Vu sleeves is untreated T500 film manufactured by Hercules, Inc. in Wilmington, Delaware. In a letter dated February 9, 1983, Henry K. Graves (district sales manager at the time, Mr. Graves is currently process systems manager) of Hercules, Inc. in Norcross, Georgia, told Kleer-Vu that: "This information is of interest to customers concerned with protection of photographic materials and archival documents. Concern about pH, sulfur content and peroxide level is a result of past problems with glassine, paper and paperboard storage envelopes or containers. Hercules T500 untreated polypropylene films have been tested at an independent test lab and the results were as follows: **(1)** pH — heavy gauge T500 films are neutral and therefore have a pH of 7.0; **(2)** Active Hydrogen — none; this is expected in view of the pH results; **(3)** Peroxide Content — not detectable (limit of detection — 0.015 mcg/cm^2); **(4)** Sulfur Content — not detectable (limit of detection — 3ppm); T500 also passes the Photographic Activity Test (**ANSI PH1.53-1978** Section 6.1)." The Photographic Activity Test referred to here is the same as Sec. 5.1 in the 1986 revision of **ANSI PH1.53;** the test apparently was performed only with a limited number of older black-and-white and color materials.
16. The C-Line polypropylene notebook page enclosure which stuck to photographs was stored in a New York City apartment. Situated on the top floor of a non-air-conditioned building, the apartment was hot and humid during the summer months — and cool and dry during the winter.
17. Jack VerMeulen, Quality Control Manager, C-Line Products, Inc., letter to this author, December 12, 1984.
18. Clyde V. Detter, "Films, Polyethylene, High-Density," in **Packaging Encyclopedia & Yearbook — 1985,** William C. Simms, ed., Cahners Publishing Company, Des Plaines, Illinois, 1985, p. 62.
19. Robert Hagle, "A Negative on Filing," letter to the editor in **Camera 35,** Vol. 35, No. 12, December 1980, p. 6.
20. Kenneth C. Smeltz, "Why Do White Fabrics and Garments Turn Yellow During Storage in Polyethylene Bags and Wrappings? — A Growing Problem," **Textile Chemist and Colorist,** Vol. 15, No. 4, April 1983, pp. 17–21.
21. American National Standards Institute, Inc., see Note No. 13.
22. Eastman Kodak Company, see Note No. 3, p. 9.
23. Ilford, Inc., **Ilford Galerie,** Ilford, Inc., West 70 Century Road, Paramus, New Jersey 07652, 1979, p. 16.
24. Polaroid Corporation, **Storing, Handling and Preserving Polaroid Photographs: A Guide,** Publication No. P2064, Polaroid Corporation, Cambridge, Massachusetts, 1983, p. 29.
25. R. Scott Williams, "Commercial Storage and Filing Enclosures for Processed Photographic Materials," **Second International Symposium: The Stability and Preservation of Photographic Images,**

Ottawa, Ontario, August 25–28, 1985, (Printing of Transcript Summaries), IS&T, The Society for Imaging Science and Technology, 7003 Kilworth Lane, Springfield, Virginia 22151; telephone: 703-642-9090. See also: Robert E. Mayer, "Oily Droplets on Slides," (in Images and Answers), **Photomethods,** Vol. 27, No. 9, September 1984, p. 52. For discussion of the possible formation of hydrochloric acid by the decomposition of polyvinyl chloride see: Thomas W. Sharpless, "Corrosion: The Problem of Storage," **The Numismatist,** Vol. 93, No. 10, October 1980, pp. 2450–2454. Also: Ed Reiter, "Little 'PVC' Holders Can Cause Big Problems," (Numismatics), **The New York Times,** January 25, 1981, Sec. D, p. 35.

26. Ed Scully, "Preservation, Duplicating, Temperature Control — Did I Ever Get My Foot in My Mouth in Record Time! Now to Get It Out By Answering Your Letters About Recent Columns," **Modern Photography,** Vol. 41, No. 8, August 1977, pp. 47ff.
27. Robert D. Shipp, "Letter to the Editor," **Modern Photography Magazine,** Vol. 42, No. 1, January 1978, pp. 6, 8.
28. Paul A. Elias, "Letter to the Editor," **Modern Photography,** Vol. 44, No. 8, August 1980, p. 83.
29. Herbert Keppler, "Why Chance Damaging Slides in PVC Pages?", **Modern Photography,** Vol. 45, No. 8, August 1981, pp. 68–70.
30. W. F. van Altena, "Envelopes for the Archival Storage of Processed Astronomical Photographs," **AAS Photo-Bulletin,** No. 1, 1975, pp. 18–19. The article listed two sources for Tyvek envelopes: Mail Well Envelopes, Division of Georgia-Pacific Lumber Company, 5445 North Alston Avenue, Chicago, Illinois 60630, and Coast Envelope Company, 2930 South Vail Avenue, Los Angeles, California 90040. Cost of the envelopes was reported to be similar to that of high-quality paper envelopes.
31. Eastman Kodak Company, **Conservation of Photographs** (George T. Eaton, editor), Eastman Kodak Company, Rochester, New York, March 1985, p. 95.
32. American National Standards Institute, Inc., see Note No. 13.
33. Eugene Ostroff, **Conserving and Restoring Photographic Collections,** American Association of Museums, Washington, D.C., 1976, p. 14.
34. James McCord, EROS Data Center, Sioux Falls, South Dakota, interview with this author during visit to Earth Resources Observation System (EROS) Data Center, December 1979. The EROS Data Center is operated by the U.S. Geological Survey, U.S. Department of the Interior. The two orbiting Landsat satellites and associated systems, which originate many of the images processed by the EROS Data Center, were sold by the U.S. Government on October 18, 1985 to the Earth Observation Satellite Company (Eosat), a joint venture of Hughes Aircraft Company and RCA Corporation (RCA was acquired by the General Electric Company in late 1985).
35. Eastman Kodak Company, see Note No. 31, p. 97.
36. For encapsulation using sheets of uncoated polyester, such as DuPont Mylar D, 3M Scotch Double-Coated Film Tape No. 415 is recommended: 3M Company, Industrial Specialties Division, Bldg. 220-7E-01 — 3M Center, St. Paul, Minnesota 55144; telephone: 612-733-8202. This tape is available from many suppliers, including Light Impressions Corporation and Talas Inc. (see **Suppliers** list at the end of this chapter for addresses).
37. Preservation Office of the Library of Congress, **Polyester Film Encapsulation,** Library of Congress, Washington, D.C., 1980.
38. Jane Booth, San Diego Historical Society, telephone discussion with Carol Brower, December 10, 1982.

Additional References

Joan Agranoff, ed., **Modern Plastics Encyclopedia 1984/1985,** Vol. 61, No. 10A, McGraw-Hill Inc., New York, New York, 1984.

Gary Albright, "Which Envelope? Selecting Storage Enclosures for Photographs," **Picturescope,** Vol. 31, No. 4, Winter 1985, pp. 111–113.

W. F. van Altena, "Report of the Subgroup on the Storage of Astronomical Plates for Archival Purposes," **AAS Photo-Bulletin,** No. 2, 1972, pp. 15–17.

Calvin J. Benning, **Plastic Films for Packaging,** Technomic Publishing Co., Inc., Lancaster, Pennsylvania, 1983.

J. H. Briston and L. L. Katan, **Plastics Films,** 2nd ed., (George Goodwin in association with the Plastics and Rubber Institute), Longman Group Limited, Harlow, England, 1983.

Helen D. Burgess, "Evaluation of Paper Products: With Special Reference to Use with Photographic Materials," **Topics in Photographic Preservation – Volume Four** (compiled by Robin E. Siegel), Photographic Materials Group of the American Institute for Conservation, 1991, pp. 96–105. Available from the American Institute for Conservation, Suite 340, 1400 16th Street, N.W., Washington, D.C. 20036; telephone: 202-232-6636.

T. J. Collings, **Archival Care of Still Photographs,** Society of Archivists Information Leaflet No. 2, Society of Archivists, 56 Ellin Street, Sheffield S1 4PL, England, 1986.

Klaus B. Hendriks, together with Brian Thurgood, Joe Iraci, Brian Lesser, and Greg Hill of the National Archives of Canada staff, **Fundamentals of Photographic Conservation: A Study Guide**, published by Lugus Publications in cooperation with the National Archives of Canada and the Canada Communication Group, 1991. Available from Lugus Productions Ltd., 48 Falcon Street, Toronto, Ontario, Canada M4S 2P5; telephone: 416-322-5113; Fax: 416-484-9512.

Margaret Hobbie, "Paper and Plastic Preservers for Photographic Prints and Negatives," **History News,** Vol. 35, No. 10, October 1980, pp. 42–45.

Dan O'Neill, "Filing Slides and Negs," **Technical Photography,** Vol. 14, No. 9, September 1982, pp. 38, 40, 43.

Debbie Hess Norris, "The Proper Storage and Display of a Photographic Collection," **Picturescope,** Vol. 31, No. 1, Spring 1983, pp. 4–10.

Mary Kay Porter, "Filing Enclosures for Black and White Negatives," **Picturescope,** Vol. 29, No. 3, Fall 1981, p. 108.

James M. Reilly and Douglas W. Nishimura, "Improvements in Test Methods for Photographic Storage Enclosures," presentation at the SPSE (The Society for Imaging Science and Technology) 40th Annual Conference and Symposium on Hybrid Imaging Systems, Rochester, New York, May 19, 1987.

James M. Reilly, Douglas W. Nishimura, Luis Pavao, and Peter Z. Adelstein, "Photo Enclosures Research and Specifications," **Topics in Photographic Preservation – Volume Three** (compiled by Robin E. Siegel), Photographic Materials Group of the American Institute for Conservation, 1989, pp. 1–7. Available from the American Institute for Conservation, Suite 340, 1400 16th Street, N.W., Washington, D.C. 20036; telephone: 202-232-6636.

Mary Lynn Ritzenthaler, "Storage Enclosures for Photographic Materials," (SAA Basic Archival Conservation Program), The Society of American Archivists, **SAA Newsletter,** November 1984.

Lloyd R. Whittington, **Whittington's Dictionary of Plastics,** (Society of Plastics Engineers), Technomic Publishing Co., Inc., Lancaster, Pennsylvania, 1978.

(Turn Page for Chapter 14 Suppliers List)

A Photech hot-seal plastic sleeving machine in operation at H&H Color Lab under the watchful eye of Darrell Owens, a film processing technician. H&H, a leading professional portrait and wedding lab located near Kansas City in Raytown, Missouri, processes and proofs up to 2,000 rolls of color negative film a day (mostly in the 120/220 format). Sleeving is done immediately after processing to protect the film from dust and scratches. The film is video analyzed, proofed, and shipped to customers without ever removing the film from the sleeves.

Suppliers

Envelopes and Sleeves

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Moonachie, New Jersey 07074
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Toll-free: 800-333-4466

Clear File, Inc.
P.O. Box 593433
Orlando, Florida 32859-3433
Telephone: 407-851-5966
Toll-free: 800-423-0274 (outside Florida)

C-Line Products, Inc.
1530 East Birchwood Avenue
P.O. Box 1278
Des Plaines, Illinois 60018
Telephone: 312-827-6661
Toll-free: 800-323-6084 (outside Illinois)

Conservation Resources International, Inc.
8000-H Forbes Place
Springfield, Virginia 22151
Telephone: 703-321-7730
Toll-free: 800-634-6932 (outside VA)

Filmguard Corporation
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Escondido, California 92033
Telephone: 619-741-7000
Toll-free: 800-777-7744

Hollinger Corporation
4410 Overview Drive
P.O. Box 8360
Fredericksburg, Virginia 22404
Telephone: 703-898-7300
Toll-free: 800-634-0491 (outside VA)

Kleer-Vu Plastics Corporation
Kleer-Vu Drive
P.O. Box 449
Brownsville, Tennessee 38012
Telephone: 901-772-5664
Toll-free: 800-238-6001 (outside Tenn.)

Light Impressions Corporation
439 Monroe Avenue
Rochester, New York 14607-3717
Telephone: 716-271-8960
Toll-free: 800-828-6216

Lineco Inc.
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Holyoke, Massachusetts 01041
Telephone: 413-534-7815
Toll-free: 800-322-7775

National Photo Products Company
4400 Santa Ana Street
P.O. Box 1038
Cudahy, California 90201
Telephone: 213-771-1211
Toll-free: 800-221-9149 (in California)
Toll-free: 800-421-6184 (outside Calif.)

Envelopes and Sleeves

NegaFile Systems, Inc.
P.O. Box 78
Furlong, Pennsylvania 18925
Telephone: 215-348-6342

Photofile, Inc.
2020 Lewis Avenue
Zion, Illinois 60099
Telephone: 708-872-7557
Toll-free: 800-356-2755

Picture Pocket Corporation
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San Marcos, California 92069
Telephone: 619-744-2425
Toll-free: 800-369-0852

Print File, Inc.
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Apopka, Florida 32703
Telephone: 407-886-3100

Reeves Photo Sales, Inc.
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Dallas, Texas 75247-4598
Telephone: 214-631-9730
Toll-free: 800-241-7830 (in Texas)
Toll-free: 800-527-9482 (outside Texas)

Savage Universal Corporation
800 West Fairmont Drive
Tempe, Arizona 85282
Telephone: 602-967-5882
Toll-free: 800-624-8891

Talas Inc.
Ninth Floor
213 West 35th Street
New York, New York 10001-1996
Telephone: 212-736-7744

Taylor Made Company
P.O. Box 406
Lima, Pennsylvania 19037
Telephone: 215-459-3099

20th Century Plastics, Inc.
P.O. Box 30810
Los Angeles, California 90030
Telephone: 213-731-0900
Toll-free: 800-767-0777

Vue-All, Inc.
P.O. Box 1690
Ocala, Florida 32678
Telephone: 904-732-3188
Toll-free: 800-874-9737 (outside Florida)

High-Density Polyethylene Sleeving Material in Rolls; Sleeving Machines

Agfa-Copal, Inc.
2605 Fernbrook Lane
Plymouth, Minnesota 55477
Telephone: 612-553-0366
Toll-free: 800-866-6692 (outside Minn.)
(Copal sleevers and sleeving material)

Byers Industries, Inc.
6955 S.W. Sandburg Street
P.O. Box 23399
Portland, Oregon 97223
Telephone: 503-639-0620
Toll-free: 800-547-9670

CPAC, Inc.
2364 Leicester Road
Leicester, New York 14481
Telephone: 716-382-3223

Crown Photo Systems, Inc.
P.O. Box 1298
Everett, Washington 98206
Telephone: 206-339-1518
Toll-free: 800-228-1518 (outside Wash.)
(Crown sleevers and sleeving material)

DOI, Inc.
15 East 42nd Street
New York, New York 10017
Telephone: 212-661-0876
(DOI sleevers and sleeving material)

Minilab Specialties, Inc.
17762 Metzker Lane
Huntington Beach, California 92647
Telephone: 714-842-0059
Toll-free: 800-633-8091
(Labokey sleevers and sleeving material)

Noritsu America Corporation
69 Noritsu Avenue
Buena Park, California 90620
Telephone: 714-521-9040
(Noritsu sleevers and sleeving material)

Hot-Seal Plastic Sleeving and Automatic Application Machines

Climax, Ltd.
780 Fort Bragg Road
P.O. Box 399
Willits, California 95490
Telephone: 707-459-4535
Toll-free: 800-444-0977
(Climax [Hostert-style] hot-seal sleevers; polypropylene sleeving material)