4. The Effects of Print Lacquers, Plastic Laminates, 3M Photogard, and UV-Absorbing Plastic Filters

The Myth of UV Protection for Ektacolor, Fujicolor, and Similar Color Prints

> As for the results of my experiment [with McDonald UV-absorbing print lacquer], I detected no difference in the degree of fading between the surface of the print which was not sprayed, and the surface area that was sprayed twice. . . . I have concluded that if a "UV inhibitor" does exist at all, its only value is as a promotional sales tool [for the lacquer manufacturers].[1]
>
> Marty Rickard
> *Professional Photographer*
> January 1990

One of the most persistent beliefs in photography is that color print fading is caused primarily by exposure to ultraviolet radiation, and not by the effects of visible light. A 1970 Kodak publication stated: "Ultraviolet radiation in the illumination source is the chief cause of fading in color photographs."[2] Therefore, so the logic went, all one had to do to prevent fading of displayed color prints was to filter out UV radiation.

Since the early 1980's, however, Ektacolor, Fujicolor, Konica Color, Agfacolor, and most other modern color papers have been manufactured with a protective UV-absorbing emulsion overcoat on top of the image layers. Because of this built-in protection, almost all of the fading that occurs in these papers under normal display conditions — even when the prints are exposed directly to the UV-rich illumination of bare fluorescent lamps — is caused by visible light. Covering a print with an additional UV filter, or spraying it with a UV-absorbing lacquer, will do little if any good in reducing the rate of fading during display.

As discussed in Chapter 3, a good method for assessing the possible benefit of UV filtration for a particular type of color print is to test the material when it has been covered with Plexiglas UF-3, a sharp-cutting ultraviolet filter that removes virtually all UV radiation and even some short-wave blue light. UF-3 can be considered a "perfect" UV filter. If little improvement is noted with UF-3, one can be confident that other UV-filtering products will be of little or no benefit.

Unannounced, Kodak began manufacturing Ektacolor paper with a UV-absorbing emulsion overcoat around 1981, and this effectively eliminated the adverse effects of UV radiation in nearly all display conditions (see **Figure 4.1**). Other manufacturers now have also added this additional protective layer. When this book went to press in 1992, Ilford Ilfochrome (called Cibachrome, 1963–1991), Polaroid Polacolor peel-apart prints, Fuji Dyecolor, and Kodak Dye Transfer were the only traditional color print materials not incorporating a UV-absorbing emulsion overcoat.

See page 147 for Recommendations

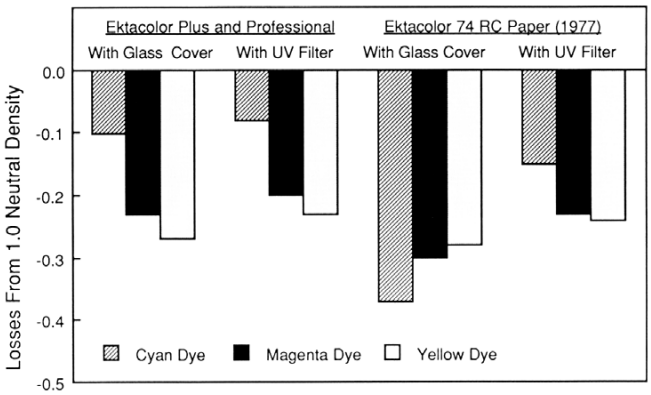
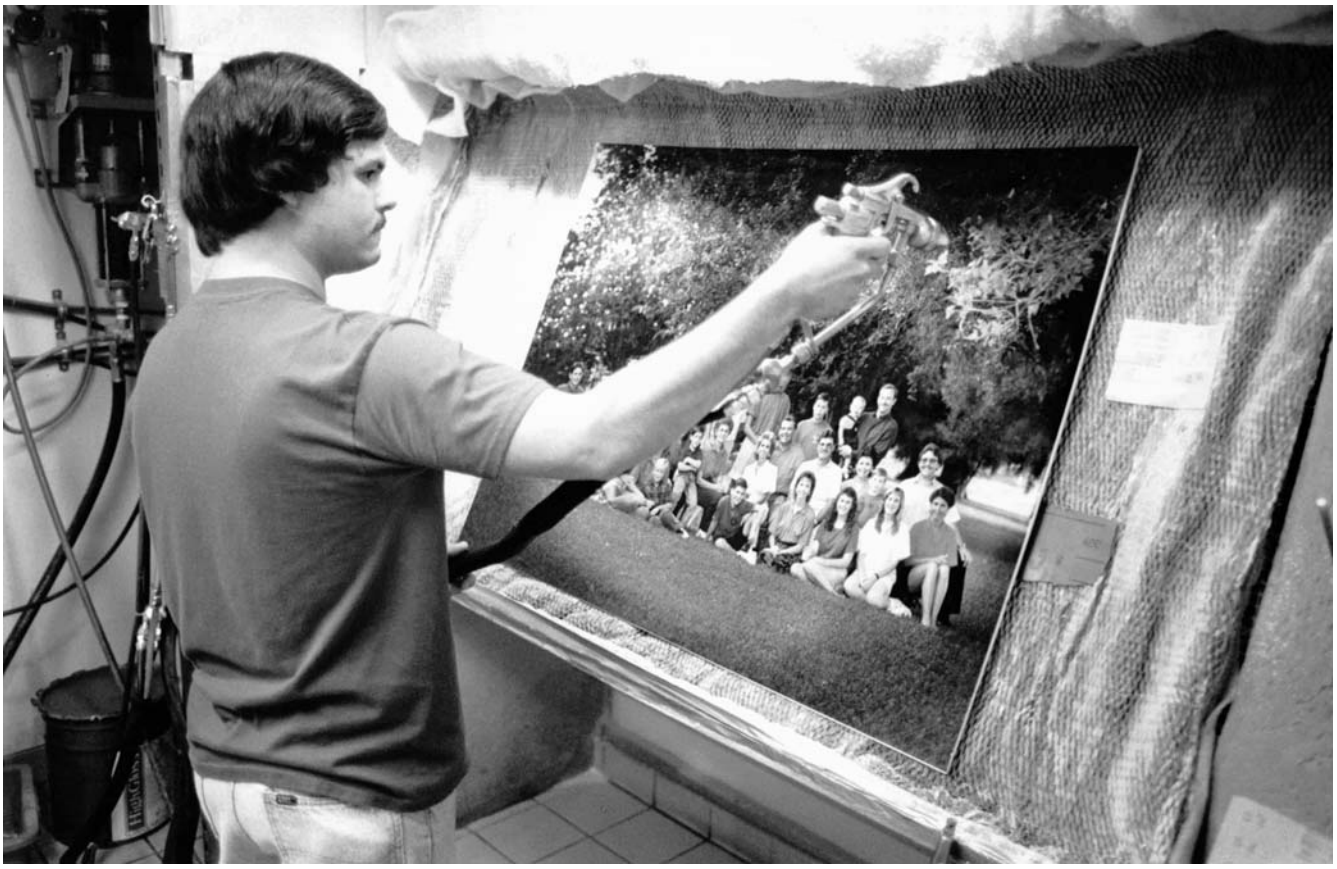


Figure 4.1 Kodak Ektacolor Plus prints (Ektacolor Professional, Ektacolor Edge, Ektacolor Portra II, Ektacolor Supra, and Ektacolor Ultra prints have similar fading characteristics) and earlier Ektacolor 74 RC prints exposed to north daylight for a period of 1,250 days (3.5 years). With the prints located only a few feet from a large north-facing glass window (average intensity over a 24-hour period of 0.78 klux), this is a worst-case indoor display situation. With Ektacolor Plus, the glass-covered print faded only slightly more than the print covered with Plexiglas UF-3, a sharp-cutting UV filter that absorbs virtually all UV radiation and even some short-wavelength blue light. Current Ektacolor papers and similar products made by Fuji, Konica, and Agfa are manufactured with an effective UV-absorbing emulsion overcoat (as well as one or more UV-absorbing layers within the emulsion), so framing such prints with a UV-filtering material offers little if any additional protection. Until the early 1980's, Ektacolor 74 RC paper and similar color negative print papers supplied by other manufacturers were made without a UV-absorbing emulsion overcoat, and the cyan dye in particular was adversely affected by illumination sources with a high UV content.

Kodak Ektatherm Electronic Print Paper, a thermal dye transfer paper supplied by Kodak for use with its electronic digital and video printers, does not have a UV-absorbing overcoat and suffers devastating fading when illuminated with direct, bare-bulb fluorescent lamps. When Ektatherm prints are displayed in this manner, ordinary window glass affords a considerable improvement in image stability. And, as discussed in Chapter 3, Ektatherm



October 1990

H&H Color Lab, located near Kansas City in Raytown, Missouri, is a leading Midwest lab serving professional portrait and wedding photographers. As is the case with most professional portrait labs, H&H's customers usually request lacquering on larger-size prints. Shown here is print sprayer Tom White lacquering a color print. H&H was the first professional portrait and wedding lab in the U.S. to switch from Kodak Ektacolor paper to Fujicolor paper. The change in color papers, which took place in 1991, was made because of the much better image stability of the Fuji product (see Chapter 8).

prints are an example of a print material for which a UV-absorbing filter such as Plexiglas UF-3 offers a further, significant improvement in light fading stability compared with covering the prints with glass.

Thermal dye transfer and ink jet "electronic" print materials supplied by other manufacturers also are made without a UV-absorbing overcoat. The same holds true for prints made with a Canon Color Laser Copier (a xerographic color copier), which have very good image stability — much better than that of Ektacolor prints — when framed under glass. But when the Canon color prints are exposed to bare-bulb fluorescent lamps, both the cyan and magenta colorants suffer markedly increased fading rates, and under this condition, the overall light fading stability of the prints is inferior to that of Ektacolor prints.

Print Lacquers

Portrait and wedding photographers frequently coat color prints with a spray lacquer (currently available photographic lacquers generally are made with transparent cellulose nitrate [nitrocellulose] plastic dissolved in a mixture of solvents, plasticizers, and, in many cases, matting agents; a thin, hard layer of the plastic remains after the solvents evaporate). Lacquers come with a number of different surface gloss characteristics — from a very flat matte finish to a brilliant high gloss. Print lacquers are supplied both in aerosol cans for easy spray application and in larger bulk containers for commercial paint-spraying equipment; brush application is not recommended.

Special lacquers are available which, after drying, have surface characteristics unlike current photographic papers. McDonald Pro-Tecta-Cote Florentine, applied over coats of conventional or textured lacquers, dries with a reticulated (cracked) surface intended to simulate old and deteriorated oil paintings. Other "special effects" lacquers, such as McDonald Pro-Texture Lacquer, can produce simulated brush strokes on the surface of a print.

In addition to physically protecting a print from fingerprints, moisture, and physical damage during handling, lacquering covers the retouching and spotting work often done on prints sold by professional photographers. Heavy retouching and air-brushing usually result in changes in print surface gloss in the area where the retouching was done (sometimes a matte lacquer is applied first to provide a "toothed" surface receptive to pencil retouching), and a final coat of lacquer will cover the retouching and provide a uniform surface to the print.

Perhaps the most compelling reason for using print lacquers is to permit color prints to be framed directly against

Recommendations

- **Plastic laminating films:** If a protective surface coating for prints is needed (e.g., for large display prints where framing under glass may not be practical), pressure-sensitive plastic laminating films made by Coda, Inc. and MACtac Permacolor are recommended (laminating films supplied by other firms were not tested and therefore cannot be recommended at this time). Laminates must be applied after retouching and spotting are completed. With Ektacolor, Fujicolor, and similar color negative print papers displayed in typical indoor conditions, there probably is no worthwhile benefit to be gained from ultraviolet-filtering laminating materials.

- **Laminating proved better than lacquering in this author's tests.** For coating Ektacolor prints, none of the print lacquers tested performed as well as the plastic laminating films made by Coda, Inc. and MACtac Permacolor. (The Sureguard-McDonald 900-series non-cellulose-nitrate lacquers introduced in 1992 were not available in time to be evaluated before this book went to press.) Although not tested, liquid surface-texturing finishes generally contain the same potentially harmful ingredients as lacquers and therefore cannot be recommended.

- **If a lacquer must be used, Lacquer-Mat lacquers and the new Sureguard-McDonald 900-series non-cellulose-nitrate lacquers introduced in 1992 tentatively are recommended.** This author's accelerated aging tests showed that older McDonald lacquers and probably all Sureguard brand lacquers will yellow over time to an unacceptable degree; for this reason, these lacquers should be avoided. (Sureguard brand lacquers should not be confused with the new Sureguard-McDonald 900-series lacquers introduced in 1992. Both product lines are now supplied by Sureguard Inc., although the company has indicated that the Sureguard brand will probably be discontinued in favor of the Sureguard-McDonald products in the future.) With Fujicolor prints, Ektacolor prints, and most other types of modern print materials displayed in typical indoor conditions, no worthwhile benefit is afforded by UV-absorbing lacquers. To minimize the likelihood of emulsion penetration by lacquer solvents that could cause increased rates of fading and staining when color prints are displayed or are stored in the dark, Lacquer-Mat, Sureguard-McDonald, and other print lacquers should be applied when the ambient relative humidity is as low as possible — never higher than 50%. If the ambient relative humidity is higher than 50%, lacquering should be avoided entirely and plastic laminating films used instead.

- **A proven-safe color print lacquer is needed.** A new type of print lacquer that is harmless to Fujicolor, Ektacolor, Konica Color, Agfacolor, and other chromogenic prints, even when applied in high-humidity conditions, is urgently needed (lacquers are comparatively inexpensive, so it is unlikely that they will be replaced with plastic laminating films in the cost-conscious portrait and wedding business). The lacquer itself should be stable and should not yellow upon prolonged exposure to light. The lacquer should be supplied in glossy, semi-gloss, and matte formulations.

- **3M Photogard:** 3M Photogard offers no worthwhile protection against color print fading when Ektacolor and similar prints are displayed in typical indoor conditions; in fact, tests have shown that prints coated with Photogard may fade **more rapidly** than uncoated prints. Because of this, Photogard is not recommended for professional portraits or other photographs intended for long-term display. However, because of the excellent physical protection afforded to prints by Photogard due to its resistance to abrasion, damage caused by water and other liquids, fungus growths, etc., Photogard tentatively is recommended for coating amateur snapshots, especially in the tropics and other humid areas. Photogard is also recommended for coating **duplicate** slides that must be handled frequently (e.g., in academic slide libraries). Valuable original color slides or negatives should **never** be coated with 3M Photogard.

- **KSH UV-absorbing plastic sheets:** With Kodak Ektacolor Professional Paper in accelerated fluorescent light fading tests, KSH-UVF Picture Saver Panels offered no significant reduction in fading rates when compared with glass-covered prints. The KSH UV-absorbing plastic sheets produced no worthwhile advantage even when compared with prints exposed directly to bare-bulb fluorescent illumination.

- **Do not lacquer or laminate valuable prints.** Fine art prints and important historical photographs should **never** be laminated, lacquered, treated with Photogard, or coated with any other material.

glass without the danger of the emulsion sticking to the glass during periods of high relative humidity. A separating overmat is thus unnecessary. To many photographers, this advantage alone justifies the small cost of lacquering prints. Some commercial processing labs routinely lacquer prints for customers at no extra cost; other labs have a small charge for this service — typically about $0.50 for an 8x10-inch print.

Collectively, print spotting, retouching, texturing, and lacquering are often referred to as print enhancement. Professional portrait and wedding photographers frequently do all of these things in an effort to increase a print's perceived value to the customer. Unfortunately, the image stability of these "enhanced" prints is anything but enhanced. Either separately or in concert, all of these treatments can have an adverse effect on Ektacolor Portra II (RA-4), Ektacolor Professional (EP-2), or similar chromogenic color prints and further reduce the already inadequate stability of these photographs. Ironically, the ordinary drugstore snapshot, or the "non-enhanced," low-cost portrait taken by one of the mass-market operations working out of a discount store, likely is more permanent!

Kodak's Lacquering Recommendations

For many years, Eastman Kodak recommended lacquering for both black-and-white and color prints. This 1970 statement is typical of the advice given in many Kodak publications:

> You can enhance and protect the appearance of Ektacolor prints by coating them with one of a number of lacquers available from photo dealers. These lacquers are made especially for photographic use.
>
> . . . Lacquering helps protect the surface from abrasions, finger prints, atmospheric contaminants, humidity, and dirt. You can clean a lacquered print by wiping it with a damp cloth.[3]

In Kodak's 1979 book *Preservation of Photographs,* the company said:

> Print lacquers provide physical protection from fingerprints and act as a moisture barrier. The use of a lacquer will also help prevent the emulsion of a print from sticking to glass or a material used as an overlay or for interleaving. Since lacquer formulations vary, only a lacquer designed for photographic applications should be used.[4]

However, in 1980 Kodak abruptly stopped advocating lacquers for color prints and said: "Lacquering of prints is not recommended for optimum print stability."[5] On February 28, 1982, at the annual conference of the Professional Photographers of Wisconsin, held in Oconomowoc, Wisconsin, Kodak delivered a major presentation on the adverse effects of print lacquers and other post-processing treatments on Ektacolor RC prints. The results were published by Kodak later that year.[6] The company identified several types of accelerated dye fading that could be caused by lacquers. Kodak attributed most of the problems to the solvents in print lacquers and cited alcohols, esters, ketones, and carbitols as solvents that are capable of penetrating moist gelatin, and, through a variety of chemical reactions, reducing Ektacolor dye stability and causing prints to turn blue, develop cyan spots, turn red, or develop yellowish stains. Both light fading and dark-storage stability can be affected — in some cases severely.

At the time of this writing in 1992, this author knew of no commercially available print lacquer that did not contain solvents that are potentially harmful to Ektacolor, Fujicolor, and other chromogenic color prints. At the time this book went to press in 1992, all of the print lacquers supplied by the two major U.S. manufacturers — Sureguard Inc., and Lacquer-Mat Systems, Inc. — all contained at least one of these potentially harmful ingredients.

McDonald print lacquers were for many years the most popular brand of lacquer sold in the U.S. In 1989, Sureguard Inc., of Grand Prairie, Texas, acquired marketing rights to the entire McDonald print lacquer line from McDonald Photo Products, Inc., another Texas company, and Sureguard continues to market these products under the McDonald name in addition to its previous line of Sureguard lacquers. With its two brands of lacquers, Sureguard Inc. claims it now has more than 80% of the total U.S. print lacquer market.

In 1992 Sureguard introduced the Sureguard-McDonald Pro-Tecta-Cote 900-series of non-cellulose-nitrate print lacquers which the company claims significantly reduced yellowing during aging when compared with that of the firm's previous lacquers. This improved formulation was not extended to the Sureguard line of lacquers, which the company has indicated will probably be discontinued in the future. This author did not have opportunity to evaluate the new Sureguard-McDonald 900-series lacquers before this book went to press. However, it is likely that the elimination of cellulose nitrate from the lacquer will indeed improve the performance of the lacquers, and this author tentatively recommends the new Sureguard-McDonald lacquers in addition to the Lacquer-Mat lacquers that are discussed in this chapter.

Although the Lacquer-Mat lacquers available at the time this book went to press in 1992 contained cellulose nitrate, they did *not* employ UV absorbers which, in accelerated tests with earlier McDonald and Sureguard lacquers, apparently were responsible for increasing the rate of yellowing during aging. Pending further tests, this author tentatively recommends both Lacquer-Mat lacquers and the new Sureguard-McDonald 900-series lacquers.

On inquiry to Kodak by this author, the company refused to recommend a particular lacquer for Ektacolor prints; Kodak would not even reveal which lacquer proved the least harmful in its tests. (It should be noted, however, that in Kodak's 1987 book *Photographic Retouching,* which was written for Kodak by former Kodak retouching expert Vilia Reed, it is stated: "There are lots of brands of photo lacquers on the market. You should use only lacquer that is designed for photographic use. The brand that I like best is Lacquer-Mat. . . ."[7])

Around 1984, Kodak apparently concluded that photographers and labs were going to continue to use print lacquers on a large scale regardless of the warnings of potential harm to prints, so the company adopted a new public position on the matter. Briefly stated, Kodak resumed recommending the practice of lacquering Ektacolor prints while at the same time attempting to legally insulate itself from complaints that could result from increased fading, yellowing, localized discoloration, or other problems. According to a 1985 Kodak pamphlet:

> Applying print lacquers . . . modifies the sheen of the surface, or provides a variety of surface textures. You can also use lacquers to provide physical protection from fingerprints or protection from moisture. Since not all lacquers may be compatible with the emulsions of Kodak papers, use only lacquers designed for photographic prints. Since formulations of lacquers can change, you should reevaluate them from time to time.[8]

Kodak offered advice on lacquering procedures, saying:

> If you plan to lacquer prints, observe the following guidelines so that you'll have the best chance for maintaining the dye stability of prints:

An advertisement for McDonald UV-absorbing print lacquer that appeared in a number of professional photography magazines in 1984.

1. Dry prints thoroughly before lacquering. (If you wait for a time after processing and drying before you lacquer a print, the emulsion can absorb water from humid air. If necessary, redry the print in a heated mounting press or with a hair dryer.)

2. Use only lacquers with solvents based on hydrocarbons and chlorinated or fluorinated hydrocarbons.

3. Apply multiple light coats of lacquer instead of one thick coat.

4. Lacquer in a dust-free, well-ventilated area with a relative humidity of 50 percent or less.

5. Don't let lacquered prints come into contact with glass in a frame. Don't seal prints in a tight enclosure if the lacquer contains any peroxide-forming solvents. (Don't let any prints come into contact with glass, because they can stick to it.)[9]

Despite repeated inquiries by this author, Kodak declined to identify even a single print lacquer based on "hydrocarbons and chlorinated or fluorinated hydrocarbons" (this author is not aware that any exist) and also declined to describe how a photographer could go about evaluating a lacquer to determine its suitability for color prints.[10]

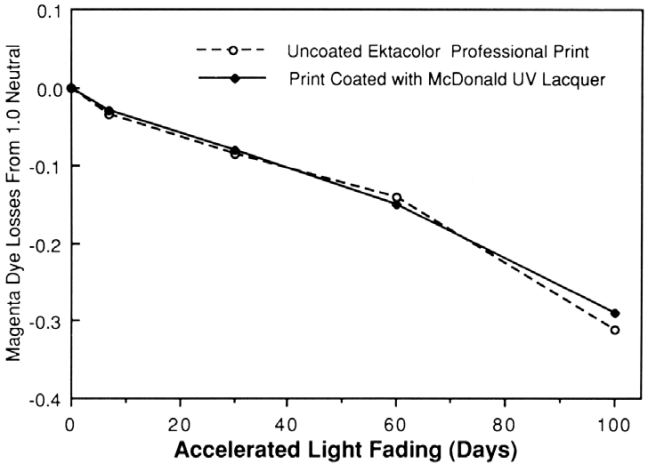


Figure 4.2 An Ektacolor Professional print coated with McDonald UV-absorbing lacquer and an uncoated print were exposed to bare-bulb fluorescent illumination in a 21.5 klux accelerated light fading test. The UV-absorbing lacquer offered no protection against image fading (fading of the magenta dye is shown here because it is the least stable of the three image dyes when the prints are exposed to light on display).

Even Kodak's 1985 museum-oriented book *Conservation of Photographs* recommended the use of print lacquers, stating:

> A large percentage of professional color portrait prints are lacquered. The technique is commonly used to enhance the print's visual appearance, to protect the print from physical degradation such as soiling, scratching or abrading, or to provide a surface with tooth when retouching is required.[11]

The book went on to say:

> Print lacquers provide physical protection from fingerprints and fungus attack, and they act as a temporary moisture barrier. The use of a lacquer will also help prevent the emulsion of a print from sticking to the glass or whatever material that is used as an overlay, matt or an interleaving. Since lacquer formulations vary, only a lacquer designed for photographic applications should be used.[12]

Since Kodak has described the ingredients for a "safe" lacquer, one might wonder why Kodak simply doesn't produce a line of suitable print lacquers and solve the whole problem. Indeed, according to an official at one large lacquer supplier, Kodak almost did just that: "Around 1984 we were approached by Kodak with an offer to sell us drums of a lacquer which they said was okay. This was a high-gloss lacquer and most of what we sell has a matting agent in it [to produce semi-gloss and matte surfaces]. But Kodak wouldn't certify it if we added a matting agent and they

said they weren't interested in producing a matte lacquer. They then dropped the whole thing." (Until the early 1970's, Kodak supplied Kodak Print Lacquer in gloss and matte versions; both were said to have been thoroughly tested by Kodak with black-and-white and color prints, and this author has been unable to learn why these apparently excellent products were discontinued.)

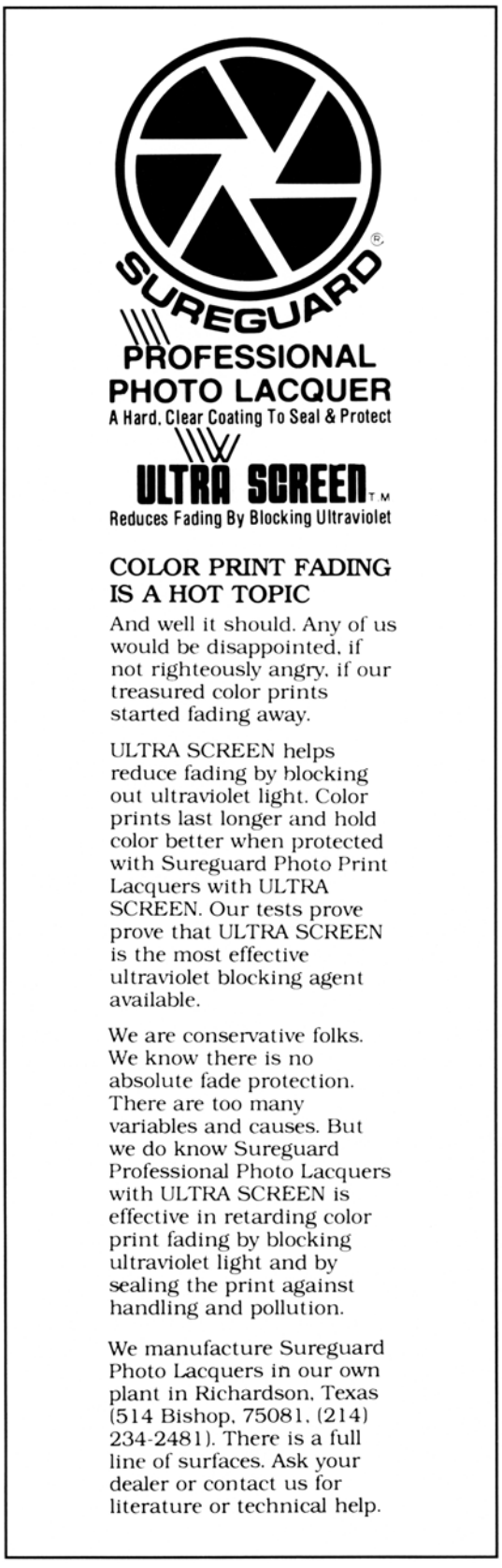
The lacquer company official, who wished to remain unnamed, went on to say, "At the current state of the market I don't think there is any product from any supplier that meets Kodak's requirements. We have even sent samples of our lacquers to Kodak for evaluation, but they won't tell us if they are good or bad." He said his company was concerned about potential problems with its current lacquers but saw no ready solutions. "Our chemists are worried about the toxicity of chlorinated hydrocarbons and we have not been able to make satisfactory nitrocellulose lacquers with hydrocarbons alone. We tried acrylics but had adhesion problems with Ektacolor prints. Kodak tells photographers to lacquer their prints but also tells them that Kodak won't be responsible if anything goes wrong. We get the blame and that leaves us in a pretty tough spot."

UV-Filtering Print Lacquers

In 1982 McDonald International, Inc. (which, at that time, had not yet been acquired by Sureguard Inc.) marketed an ultraviolet-absorbing lacquer known as McDonald UV Pro-Tecta-Cote print lacquer, which was claimed by an outside consultant hired by the company to "extend the life of a color print six to eight times." McDonald went on to say that "If it only doubles the life of the color print, it will be in demand by every photographer who cares about his valuable product."[13] One advertisement for the new lacquer showed a very faded Ektacolor print that had been displayed for more than 10 years alongside a new print made from the original negative and implied that if the new UV-absorbing lacquer were used, the new print would remain unfaded after 10 years of display. The advertisement went on to say, "The hottest topic in professional photography today is color print stability. Everyone is talking about color print fading . . . especially the photographer whose reputation is on the line. McDonald is concerned enough that we spent a lot of time and research dollars to develop a UV inhibitor for lacquer that really works."[14]

In tests conducted by this author on Ektacolor Professional Paper coated with the McDonald UV-absorbing lacquer, no improvement in image stability was observed, even with direct, bare-bulb fluorescent light in which the 313 and 365 nanometer mercury vapor emission lines were not absorbed by a glass or plastic sheet (see **Figure 4.2**). Tests done with lacquered prints made on the earlier Ektacolor 74 RC Paper, Type 2524 gave similar results. Prints coated with the UV-absorbing lacquer performed no better in light fading tests (even with direct fluorescent light) than did prints coated with a previous McDonald lacquer that did not contain a UV absorber.

In 1983 Sureguard Inc. marketed Ultra Screen UV-absorbing lacquer,[15] similar in purpose to the McDonald product. In tests conducted by this author, this lacquer also gave no improvement in dye stability of either Ektacolor Professional Paper or the earlier product that it replaced, Ekta-



A 1985 photography magazine advertisement for Sureguard UV-absorbing lacquer.

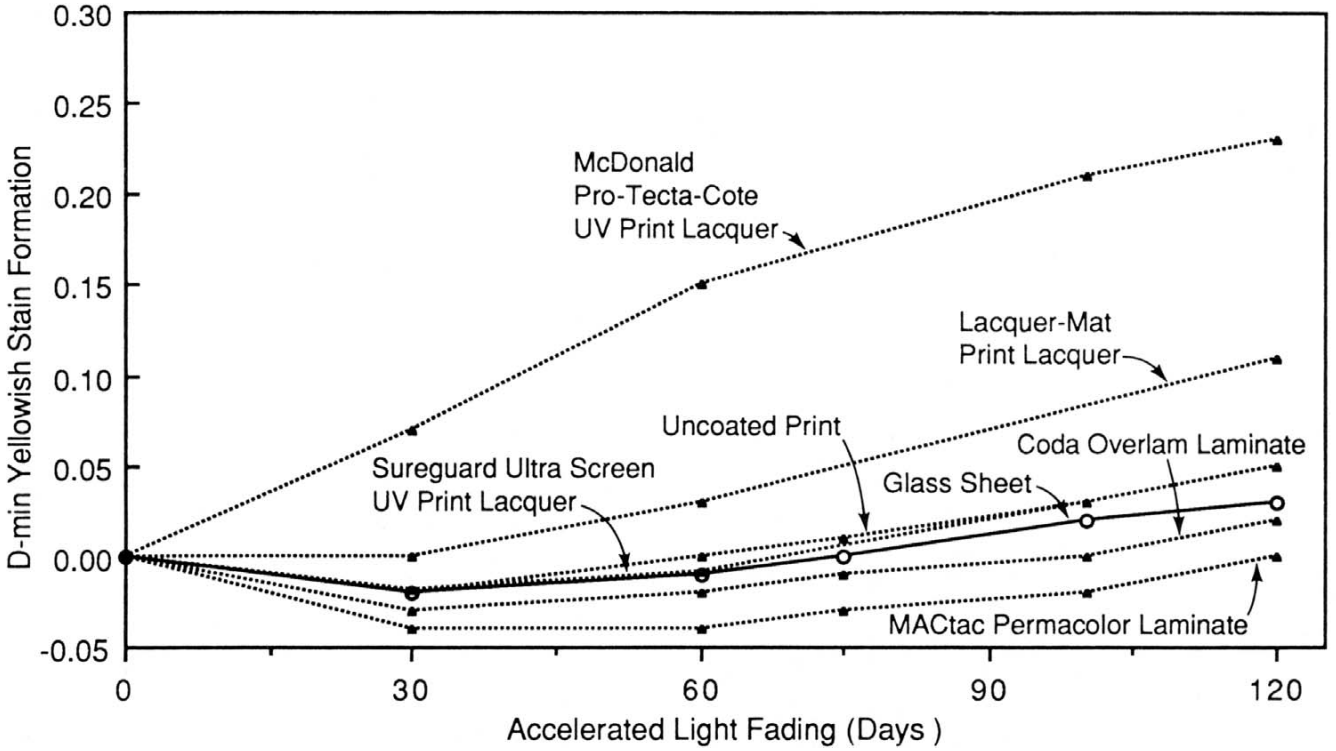


Figure 4.3 Yellowing of lacquer-coated and laminated Ektacolor Professional prints exposed to bare-bulb 21.5 klux fluorescent illumination in a temperature- and humidity-controlled light fading test. Note in particular the pronounced yellowing that occurred in the print with the McDonald UV-absorbing lacquer that was available at the time these tests were conducted (see page 148 for discussion).

color 74 RC Paper, Type 2524. The yellowing of lacquered and laminated prints illuminated with direct, bare-bulb fluorescent lamps is shown in **Figure 4.3**.

Lacquer-Mat lacquers do not contain ultraviolet absorbers; like the other lacquers, the Lacquer-Mat lacquer tested by this author offered no improvement in light fading stability of Ektacolor Professional Paper. But, as shown in **Figure 4.4**, the Lacquer-Mat lacquer performed much better in accelerated dark storage tests than either the McDonald or Sureguard lacquers available at the time these tests were conducted; in particular, the Lacquer-Mat lacquer yellowed far less than the other two products. (As noted previously, these tests did not include the Sureguard-McDonald Pro-Tecta-Cote 900-series non-cellulose-nitrate lacquers introduced by Sureguard Inc. in 1992. These new lacquers probably will yellow less than previous McDonald and Sureguard lacquers.) In preparing sample prints for the tests reported here, all of the lacquers were applied in two coats, in the manner recommended by their respective manufacturers. In the spraying area, the temperature was 70°F (21°C) and the relative humidity 60% (prior to the application of lacquer, the prints were pre-conditioned for several weeks under these conditions).

Short-term accelerated tests probably do not give an accurate indication of what might actually occur with lacquered prints in normal long-term display and storage; in particular, the kinds of disproportionate dye fading and yellowing which have been attributed to the effects of print lacquers by Kodak, and which have on occasion been observed by this author in prints on long-term display and in normal album storage in the dark, appear to be impossible to duplicate accurately with short-term accelerated tests. However, the results of this author's accelerated tests convincingly show that no improvement in the stability of Ektacolor and similar prints may be expected from lacquering, formulated with or without UV absorbers.

More meaningful dark storage staining and fading data can be obtained using the multi-temperature Arrhenius accelerated test method specified in *ANSI IT9.9-1990, American National Standard for Imaging Media – Stability of Color Photographic Images – Methods for Measuring.*[16]

Kodak has indicated that the relative humidity of the air where the lacquer is applied (and consequently the moisture content of the print emulsion) can be a major influence on the effect the lacquer may eventually have on the stability of the print. Kodak suggests a relative humidity of 50% or lower, but the photographer or processing lab will rarely if ever have control over the ambient humidity.

Lacquer-Mat, Sureguard, and McDonald lacquers (including the new Sureguard-McDonald Pro-Tecta-Cote 900-series lacquers introduced in 1992) all contain solvents which, according to Kodak, could be harmful to Ektacolor and similar chromogenic color prints, especially if the lacquers are applied in humid environments. Because of this concern, it would seem wise to avoid lacquers entirely. Lacquer fumes are also quite toxic if inhaled, and it is essential that prints be lacquered in an explosion-proof spraying hood with proper high-velocity ventilation that exhausts outdoors. If it is deemed necessary to apply a protective coating to a print, a pressure-sensitive plastic laminate,

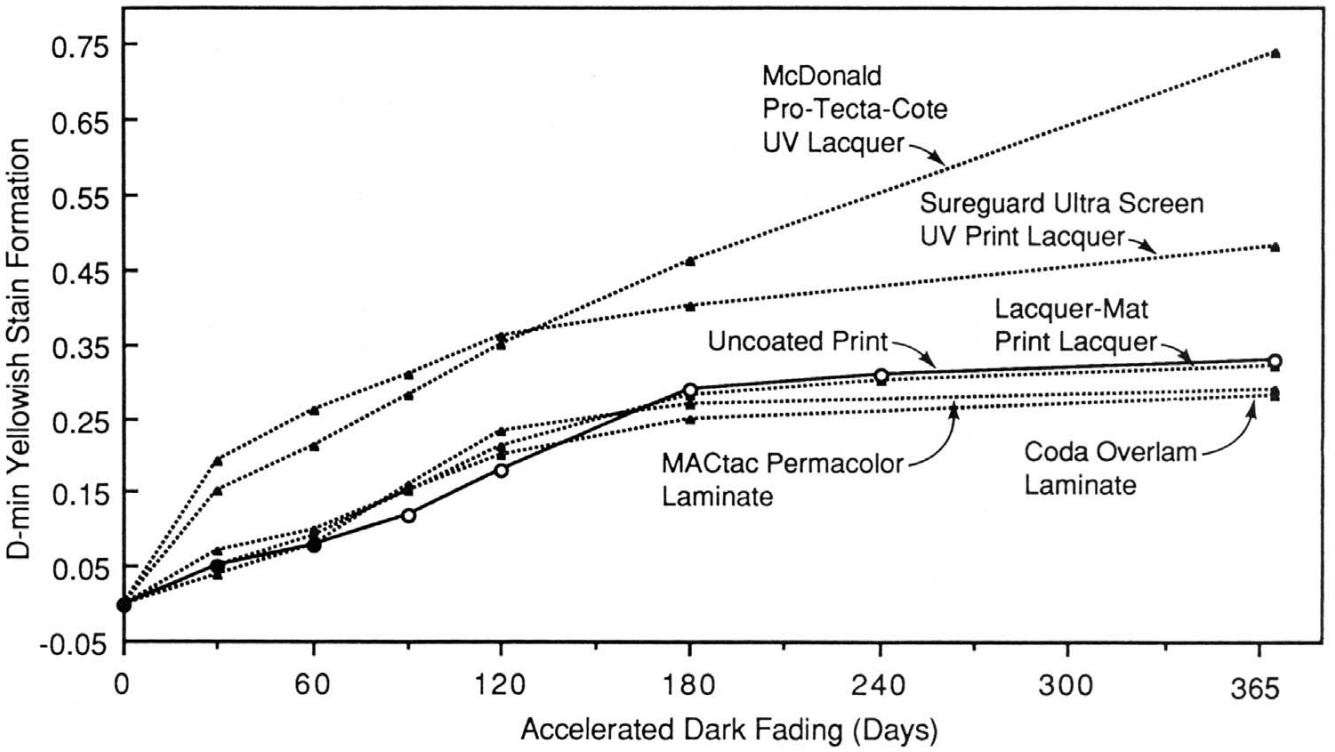


Figure 4.4 In an accelerated dark storage test conducted at 144°F (62°C) and 45% RH, Ektacolor prints coated with the McDonald and Sureguard lacquers available at the time these tests were conducted (see discussion on page 148) yellowed significantly more than prints covered with plastic laminating films or coated with Lacquer-Mat lacquer.

described below, appears to be a much better choice at present. If, for reasons of economy or other considerations, a lacquer must be used, this author's accelerated tests indicate that Lacquer-Mat lacquers are a better choice than either Sureguard or McDonald lacquers.

There is obviously a need for a safe, non-yellowing, and rapid-drying print lacquer that can be applied without difficulty in a wide range of humidity conditions. Such a lacquer would have to be carefully tested for its effects on light fading and dark-storage image stability of Ektacolor, Fujicolor, Konica Color, Agfacolor, Ilfochrome, and other common print materials (each type of print would have to be tested individually because interactions between a lacquer formulation and different print materials can vary).

There would be a considerable market for a lacquer proven to be both harmless to photographic materials and long lasting without gradual yellowish discoloration.

Pressure-Sensitive Plastic Laminates

Only since around 1980 have pressure-sensitive plastic laminates become popular in the commercial photography field. Previously, laminates were more likely to be found protecting and making tamper-proof such small photographic items as drivers' licenses and identification badges. The transparent plastic laminate coverings, coated with a pressure-sensitive adhesive, are similar in appearance to large sheets of Scotch tape and are applied with pressure rollers without heat. Pressure-sensitive laminates are now frequently used to physically protect display prints hung in food stores, restaurants, and public buildings. Such prints are usually large, and it is too expensive or otherwise impractical to frame them under glass. It is also easier and quicker to laminate a large print with an electrically powered applicator than it is to apply two or more coats of spray lacquer. Laminates, like lacquers, are available in glossy, semi-gloss, and matte surfaces.

In the U.S., most glossy-surface laminates are made with polyester (e.g., DuPont Mylar or ICI Melinex), while in Europe both polyester and polypropylene are used. Semi-gloss and matte-surface laminates are generally made of polyvinyl chloride (PVC) containing a low level of plasticizer, although other plastics are also employed. From a stability point of view, polyester would appear to have some advantages over PVC. Pressure-sensitive acrylic adhesives with UV stabilizers are used with most if not all currently available laminating products.

Although pressure-sensitive laminates are moderate in cost, they are considerably more expensive than spray lacquers, and this has limited the popularity of laminates outside of the commercial display field; in particular, laminates are less common in wedding and portrait markets, where lacquers have had wide popularity for many years.

One of the leading suppliers of pressure-sensitive laminates is MACtac PermaColor of Stow, Ohio.[17] MACtac's products, which include pressure-sensitive "cold-mounting" adhesives, were initially marketed under the MACtac CoolMount name. In 1984 the name was changed to Permacolor after MACtac acquired the assets of the defunct PermaColor Corporation, which in 1983 had unsuccessfully

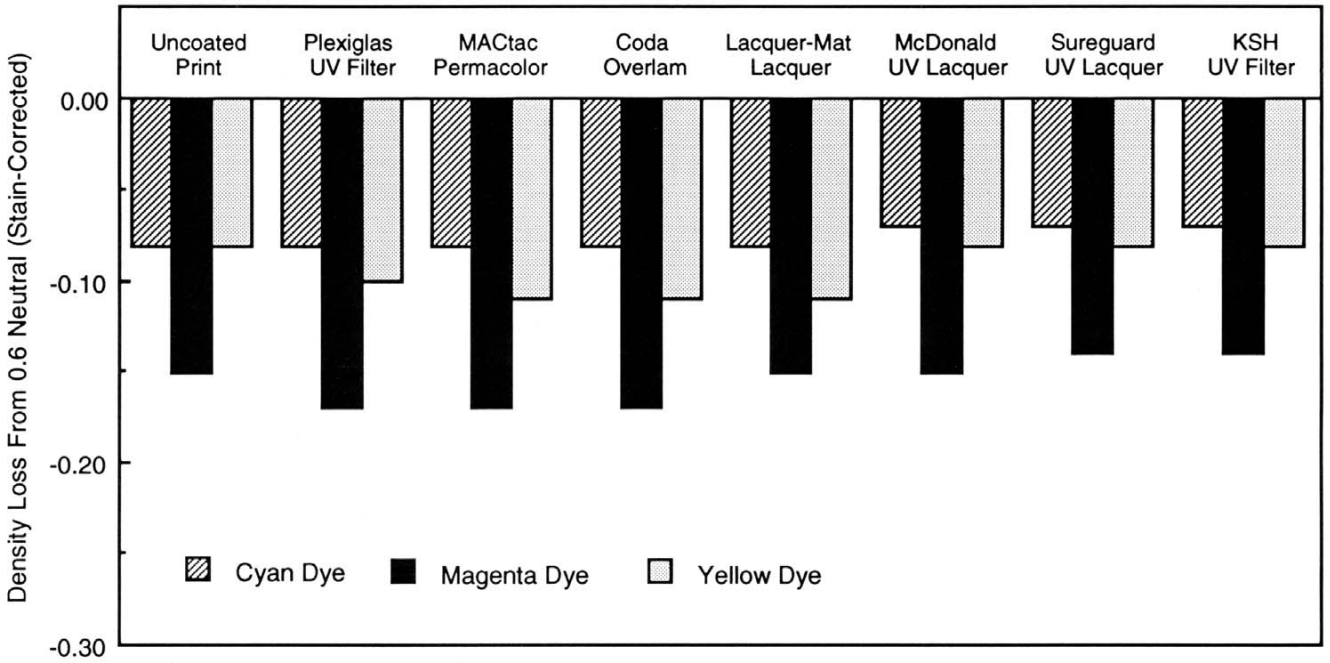


Figure 4.5 Laminated and lacquered Ektacolor Professional prints exposed to high-intensity 21.5 klux bare-bulb Cool White fluorescent illumination for 60 days in an accelerated light fading test (circulating air at the surface of the prints was maintained at 75°F [24°C] and 60% RH). When compared with the uncoated print, none of these products offered any worthwhile protection against light fading. The somewhat increased magenta dye fading that was measured in the print covered with a Plexiglas UF-3 ultraviolet filter and the prints laminated with MACtac and Coda plastic films is an artifact of the reduced stain levels that occurred in these prints and is not considered significant.

attempted to market small, UV-filtering, hermetically sealed frames for color prints under the Permacolor name. (The frames produced by PermaColor were claimed to reduce fading of Ektacolor prints, although in this author's tests they proved ineffective in this regard.) MACtac's PermaGard laminating materials have been extensively advertised in trade publications. Company literature says: "The Permacolor System is the result of years of research and testing. America's premier scientific method for preserving image color. . . ."[18]

Although at the time the company was unable to furnish any test data to show that PermaGard products reduced the rate of print fading, there was no lack of enthusiasm about the effectiveness of the products. According to Jack McClintock of MACtac, "We are now beginning to look at extending the life of a print to within archival limits."[19]

Pressure-sensitive laminating materials are also available from a number of other firms, including Seal Products Incorporated (Seal Print Guard and Sealeze Print Shield-UV); Coda, Inc., which sells its products under the Coda Overlam name;[20] Drytac Corporation; and Ademco-Seal, Ltd.[21] Both MACtac and Coda laminates are popular in the U.S., and this author selected these for evaluation.

In this author's accelerated fluorescent light fading tests with Ektacolor Professional Paper, neither Permacolor PermaGard nor Coda Overlam offered any meaningful protection against light fading, even when compared with an uncoated Ektacolor Professional print exposed to direct, bare-bulb fluorescent illumination (**Figure 4.2**). Prints laminated with these products yellowed less than lacquered prints in these light fading tests (**Figure 4.3**), however.

In dark aging tests, the laminated prints exhibited fading and staining behavior that was generally similar to uncoated Ektacolor Professional prints. However, the laminated prints were substantially more stable and developed much lower stain levels than prints lacquered with the Sureguard or McDonald lacquers included in these tests. The Lacquer-Mat coated prints were only slightly less stable than the laminated prints. The Coda and Permacolor laminating materials included in these tests were obtained from their respective manufacturers in 1987.

Overall, this author's tests suggest that Coda and MACtac laminating materials probably are not harmful to Ektacolor prints. Although this author's tests showed that neither MACtac PermaGard nor Coda Overlam reduced the rate of light fading of Ektacolor prints, data from Ilford indicate that these products may offer substantial protection to Ilfochrome prints in many display situations.[22]

MACtac's Published Light Fading Data

In early 1987 MACtac published the results of accelerated light fading tests involving Kodak Ektacolor Plus Paper laminated with MACtac PermaGard IP-7000, a glossy polyester laminating film containing an ultraviolet absorber. "Both protected and unprotected panels were then placed in a xenon arc Weatherometer to artificially accelerate the fading process. The panels were exposed under high-intensity UV light for 359 hours at 120°F (50°C)."[23] The test indicated that the PermaGard laminate markedly reduced the fading rates of both the cyan and magenta dyes of the Ektacolor Plus print (the yellow dye faded in approximately

A practical application of plastic laminating films is the protection of photographs displayed outdoors from rain and dirt. Measuring 30x50 feet and said to be the world's largest backlit photographic billboard, this Kodak installation over the main entrance to the Marriott Marquis Hotel in New York City's Times Square features color prints made with Kodak Duratrans translucent print material that has been laminated on both sides with MACtac plastic laminating films. In outdoor applications, UV-absorbing laminating films probably offer some reduction in the rate of fading, but even at best the prints have a relatively short life. The prints on this billboard are changed at regular intervals.

the same manner in both the laminated and unprotected samples).

A xenon-arc Weatherometer of the type employed for the MACtac tests is designed to simulate the spectral distribution of direct outdoor sunlight and is essentially useless in predicting the behavior of a print material displayed indoors. The MACtac tests may be useful for simulating outdoor display, but they are simply not relevant to indoor display under normally encountered illumination conditions — including direct sunlight through window glass or bare-bulb fluorescent lamps. (This author was surprised by the greater loss of cyan than magenta dye shown in the MACtac tests — in outdoor display of an unprotected Ektacolor print in direct sunlight, this author would have expected the magenta dye loss to exceed that of the cyan dye.)

Kodak Recommends Laminates as Safer Than Print Lacquers

Laminates contain no solvents and thus avoid the principal problems of print lacquers. Eastman Kodak has generally recommended laminating materials as being less harmful to color prints than lacquers, saying: "In the cases for which we have long-term results, we have seen no adverse effect."[24] This author's tests support Kodak's recommendations in this regard. Kodak also says, "Laminates provide excellent protection from fungus and bacterial attack, moisture, dirt, and harmful gases." For outdoor display of Ektacolor papers and Duratrans "day-night" print material, Kodak advocates the use of UV-absorbing laminates applied to both sides of the prints. Kodak cautions, however, that the life of color prints displayed outdoors (an increasingly common mode of advertising) will be relatively short, regardless of the steps taken to protect the prints. The reader is referred to the Kodak booklet *Backlit Displays with Kodak Materials*[25] for an informative discussion of both indoor and outdoor display of Duratrans Display Material.

KSH UV-Absorbing Polystyrene Framing Sheets

Also of no benefit in reducing the light fading of Ektacolor Professional prints exposed to fluorescent light in tests by this author are the UV-filtering polystyrene KSH-

Klaus B. Hendriks – 1980

A 3M Company billboard on the back of a bus in Ottawa, Canada. Like many 3M advertisements for Photogard (a UV-absorbing transparent coating for photographs), this ad claims that there is "no fading" in color prints coated with Photogard. Had this been true, it would have been a most sensational development in the color photography field! In reality, as discussed in this chapter, displayed prints coated with Photogard may fade even **faster** than uncoated prints.

UVF Picture Saver Panels supplied by ICI Acrylics, Inc., of St. Louis, Missouri.[26] A KSH brochure says that this product "Protects the beauty and extends the life of treasured photographs, prints and works of art!" and is illustrated with comparison prints (made on an unidentified paper) that had been exposed to 600 hours of UV radiation (of unspecified intensity and spectral distribution).

3M Photogard Film and Print Coatings

Photogard Film Protector and Print Protector, coatings marketed by the 3M Company, have been described as a "polymerized silane, 100% solids formulation that is cured by ultraviolet radiation in a few seconds."[27] The coatings are thin, optically clear, colorless, and flexible; unlike lacquers, Photogard contains no solvents that might penetrate color print and film emulsions.

A UV-cured film-coating liquid that is similar to Photogard, but lower in cost, was introduced in 1987 by the Dacar Chemical Company of Pittsburgh, Pennsylvania, and is supplied by CPAC, Inc. under the ImageGARD name. In 1988 3M initiated a lawsuit against Dacar claiming an infringement on 3M patents. The case was settled by the two companies in 1990, and 3M granted Dacar a royalty-bearing license to manufacture and market Dacar's coatings both in the U.S. and internationally. Dacar in turn dropped its legal challenge of the validity of 3M's patents.

No information could be obtained regarding the long-term effects of Dacar ImageGARD (or Dacar REZCOAT, a related product) on color films and prints, and, at the time this book went to press, this author had not tested the coatings nor been able to compare their long-term performance with that of 3M Photogard. Therefore, until comprehensive tests can be completed, the Dacar coatings cannot be recommended.

Photogard must be applied with special equipment in a controlled environment, and has thus far been limited to photofinishing operations and to the production of motion picture release prints and microfilm work copies. In the photofinishing field, coating negatives with Photogard Film Protector is claimed to eliminate the need for negative sleeves ("sleeveless finishing"). Negatives are cut and inserted into customer print envelopes without sleeves or other physical protection, thus, it is said, saving labs time and money.

Since retouching and spotting must be done before the coating is applied, it is unlikely that Photogard will find significant acceptance for coating prints in the high-quality portrait, wedding, and commercial photography fields. 3M says that without special ultrasonic cleaning, Photo-

A 3M Photogard sheet-coating machine at Duggal Color Projects, Inc., shown here in a 3M press release photograph. Duggal is a leading New York City custom lab. Believing it had been deceived by 3M with respect to the light fading protection offered by Photogard, Duggal abandoned the coating service soon after it was inaugurated in 1982 and later filed a lawsuit against 3M. The case was settled out of court for an undisclosed amount.

gard cannot be applied to Agfachrome transparency films or Agfacolor negative films because they have a silicone coating.

Four types of Photogard coating equipment are available: **(1)** roll-film coaters for coating negatives, slides, and motion picture films; **(2)** roll-paper coaters for coating color or black-and-white RC or polyester-base prints in roll form; **(3)** sheet coaters for coating prints or films in sheet form; **(4)** strip coaters for coating individual short rolls of film (in a minilab, for example).

Automatic coaters for applying Photogard to rolls and sheets of film and paper are manufactured by CPAC, Inc.,[28] Nord Photo Engineering,[29] and CJ Laser Corporation.[30] Automatic coaters are not inexpensive; for example, the CPAC FilmCOAT 35 machine for 16mm and 35mm film sells for about $30,000. (The CPAC FilmCOAT M7040, a small, manually operated applicator for individual rolls of film, is available for about $2,000.) At the time Photogard was first introduced, the 3M Company supplied coating equipment; however, 3M discontinued making the equipment some years ago (a number of 3M machines are said to still be in operation).

In promoting Photogard, 3M has cited five characteristics of the coating that are claimed to contribute to the preservation of color prints:

1. **Protects against color fading.** In a Photogard Print Protector promotional brochure, 3M asserted that uncoated prints subjected to a fading test (unspecified) faded considerably, while "no fading" occurred in a Photogard-coated print. Other 3M literature indicates that the company based its claims on tests with direct sunlight and a xenon-arc Atlas Fadeometer. For its published pictorial examples, 3M apparently used 3M High Speed Color Paper, a now-obsolete paper that had exceedingly poor dark fading stability.

2. **Protects against spills and smudges.** Because the Photogard coatings are unaffected by common solvents at room temperatures and do not readily absorb grease, ink, oils, etc., prints can be cleaned with a cloth moistened with water or solvents. The ability to wet-clean the prints lessens the need for putting glass over displayed prints.

3. **Resists abrasion.** The coatings have exceptional abrasion resistance compared with conventional lacquer coatings or uncoated photographic emulsions. In this respect, Photogard is indeed clearly superior to any lacquer or plastic laminate on the market.

4. **Resists fungus.** 3M has reported that Photogard coatings have high resistance to fungus growth. In this respect, the coatings are probably at least equal — and probably superior — to conventional lacquer coatings.

5. **Has anti-static properties.** The coatings are claimed to greatly reduce dirt accumulation and other consequences of static electricity build-up in conditions of low relative humidity.

3M Photogard has been used at one time or another by a number of large-scale photofinishers in the U.S. and abroad,

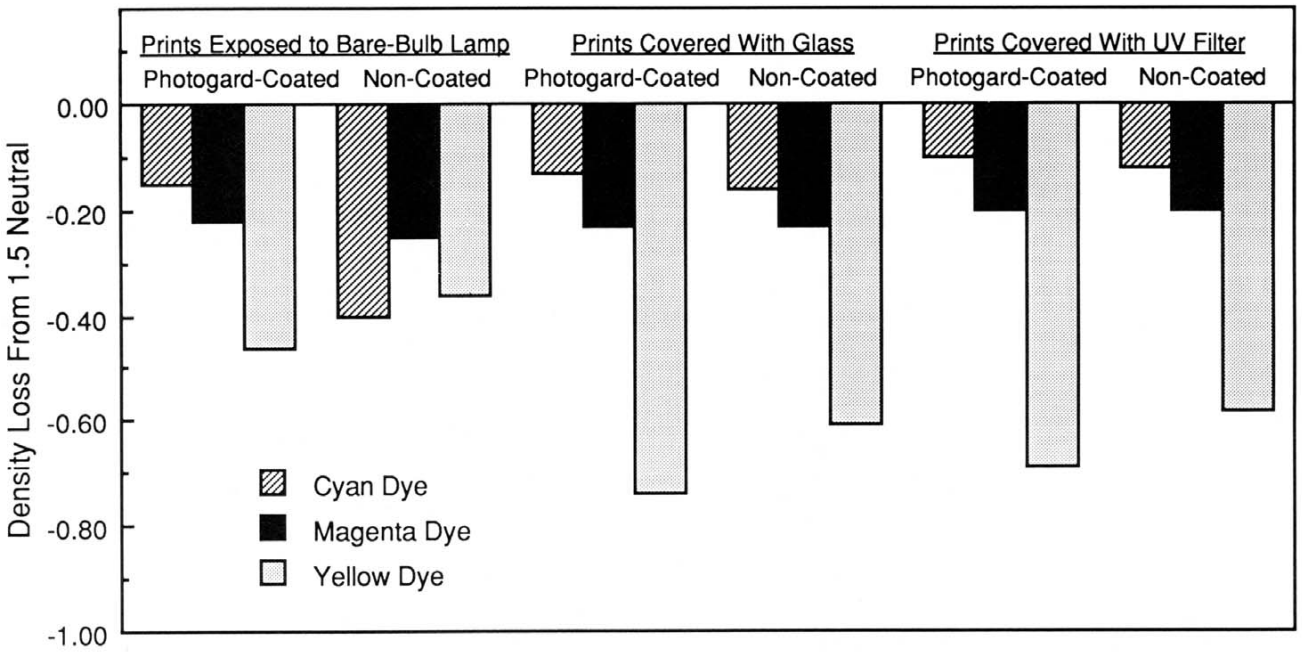


Figure 4.6 Photogard-coated and uncoated color prints compared. When exposed to 1.35 klux fluorescent illumination for 960 days (2.6 years) in a low-level accelerated light fading test, the yellow dye of the Photogard-coated prints in every case faded more than the yellow dye of the uncoated prints. The color prints in the test were made with now-obsolete 3M High Speed Color Paper. The disproportionate fading of the yellow dye in Photogard-coated prints observed in this long-term test did not occur in short-term, high-intensity tests in which the prints received the same total light exposure (circulating air at the surface of the prints was maintained at 75°F [24°C] and 60% RH in both tests).

including Brown Photo, Living Color Labs (a division of Genovese Drugstores, Inc., headquartered in Melville, New York), and Far East Laboratories, a Tokyo processing lab that coats Photogard on Ektacolor paper, selling the prints under the "Live" name and claiming reduced fading rates.

One professionally oriented lab that installed Photogard sheet-coating equipment is Duggal Color Projects, Inc., of New York City. Baldev Duggal, president of the firm, said at the inauguration of the Photogard service in 1982, "The 3M Photogard coating is one of the landmarks in the history of photography. It gives a lasting image quality to a piece of photo art, and this will add a whole new dimension to our business."[31] Duggal intended to market this service to well-known photographers and institutions such as the Museum of Modern Art "to permanently preserve their color prints." Duggal based his claims about Photogard on information supplied to him by the 3M Company. Duggal's Photogard service was an immediate market failure and was discontinued shortly after it was announced. In June 1983, Duggal filed suit against the 3M Company, claiming $207,500 in damages.[32] The case was settled out of court and never went to trial. According to Duggal: "I wanted to take 3M to the cleaners, but they offered us a damn good settlement so we accepted it."[33]

Light Fading Characteristics of Photogard-Coated Prints Made on 3M Color Paper

Figure 4.6 compares Photogard-coated and uncoated 3M High Speed Color Paper printed with neutral gray patches of an initial density of 1.5; the prints were exposed to three spectral conditions. In the direct, bare-bulb fluorescent exposures, the Photogard coating offered significant protection to the cyan dye; the loss of red density was much higher for the uncoated print under the test conditions. The 3M paper in these tests did not have a UV-absorbing emulsion overcoat (this paper, which is no longer manufactured, does have a UV-absorbing layer under the cyan layer, between the cyan and magenta layers, but it does not protect the cyan dye from UV radiation). A glass filter will effectively absorb the short-wavelength UV radiation, resulting in substantial improvement in the stability of the cyan dye in the 3M paper.

When Photogard-coated and uncoated 3M prints were exposed to glass-filtered fluorescent light, quite different behavior was observed. While the cyan dye of the Photogard-coated print faded less than the cyan dye of the uncoated print, the yellow dye of the Photogard print faded more, producing significantly greater overall color imbalance of the three image dyes resulting from unequal fading rates in the Photogard-coated print.

The greater fading of the yellow dye when the prints were covered with a sheet of glass cannot be accounted for by the fact that direct fluorescent light causes yellow stain formation (print-out of unreacted magenta coupler), which replaces the blue-light absorption of some of the faded yellow dye. There also appears to be a chemical bleaching of the yellow dye in Photogard-coated prints. This possibly is caused by reactions involving the somewhat photoreactive pigmented polyethylene layer on top of the RC paper support, next to the yellow dye layer (in a Photogard-coated

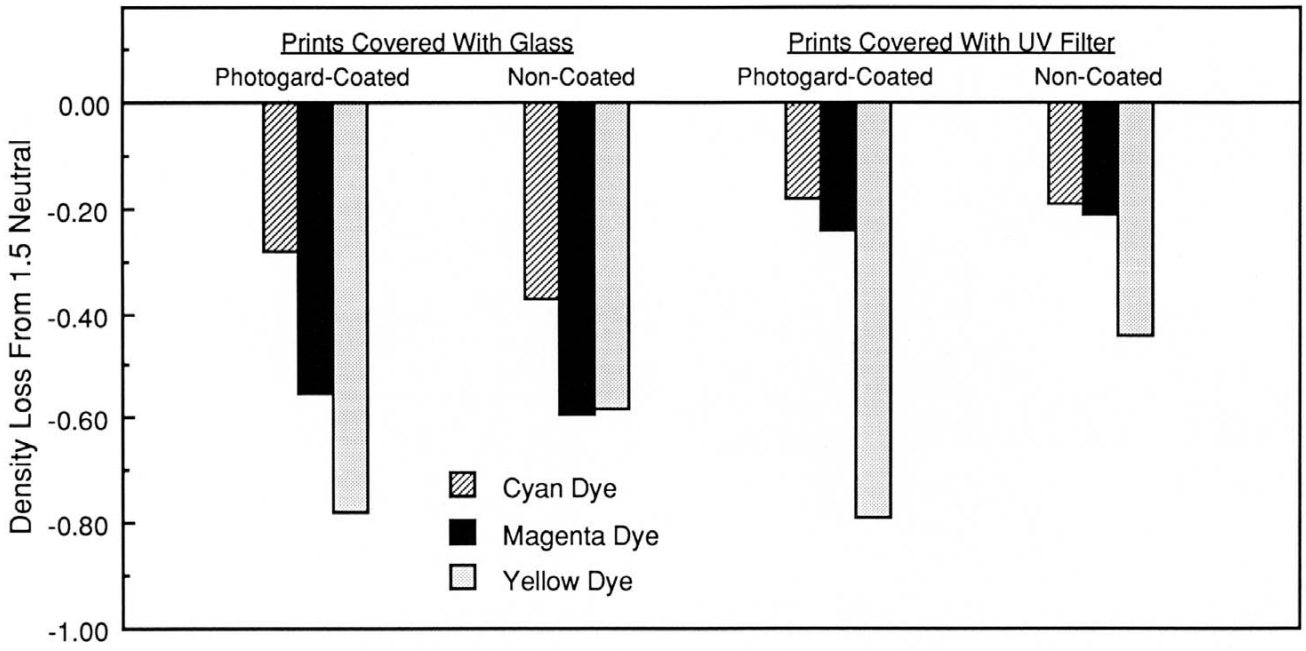


Figure 4.7 When Photogard-coated prints were exposed to north daylight through window glass (average intensity over 24 hours of 0.78 klux) for 1095 days (3 years) the yellow dye faded significantly more than did the yellow dye of uncoated prints. This was also true of the prints protected from UV radiation by Plexiglas UF-3.

print, the emulsion is "sealed" between the RC base and the Photogard coating, and this might serve to accentuate this type of yellow dye fading). In all three spectral conditions of this author's tests, the changes in blue density were greater in the Photogard-coated prints than in the uncoated prints.

Glass-filtered fluorescent light generally provides a better indication of how prints will behave on display in homes (indirect daylight filtered by window and/or framing glass) and in offices (fluorescent light filtered by glass or plastic light diffusers and/or framing glass) than any other common light source.

Long-term tests indicate that the Photogard coating reduces fading of the cyan dye but somewhat increases the fading rate of the yellow dye in 3M prints exposed to indirect daylight (through window glass); the uncoated glass-filtered print maintained the best color balance during fading (see **Figure 4.7**). In other words, in tests that are a reasonable simulation of normal print display conditions, Photogard not only failed to offer protection against dye fading in 3M color paper but was actually detrimental.

In published information on Photogard, 3M has selected high-UV test conditions and particular products (3M color paper or older versions of Ektacolor RC papers) which, in combination, make Photogard appear to significantly reduce light fading rates despite the fact that neither the test conditions nor the papers being tested are likely to be found in normal print display situations.[34] This author believes that 3M is aware of the inadequacies of its test procedures; nevertheless the company was continuing to make misleading and irrelevant claims about Photogard. For example, in the January 1987 issue of the prestigious *SMPTE Journal,* Ashwani K. Mehta, manager of Photogard products at 3M, stated: "For color prints under direct sunlight illumination, or as tested in a fadeometer that simulates direct sunlight illumination, a 6X improvement in cyan dye stability is achieved by the incorporation of UV absorbers in the Photogard coating."[35]

3M is a high-technology company, and, given its sophisticated technical resources, it is very difficult to understand why the company has persisted in citing data from irrelevant accelerated tests using a color paper that is no longer even sold in the U.S. and advertising that Photogard offers substantial protection against color print fading when in fact it does not. In some instances, 3M has even gone so far as to say that Photogard "stops fading" altogether. This is perhaps a case of marketing people running amok, having so long ago lost sight of the realities of the product they are promoting that their often-repeated claims have assumed a life of their own.

With respect to Photogard, the following conclusions can be drawn from the data presented in this chapter and from performance data supplied by 3M:

1. Photogard offers excellent abrasion resistance, and a coated print can easily be cleaned should it become soiled with fingerprints, oily dirt, etc. Photogard's abrasion resistance is greatly superior to that of uncoated print emulsions and of prints coated with lacquers or pressure-sensitive laminates.

2. Under display conditions typically found in homes and offices, Photogard offers little if any protection against light fading. With 3M color paper and probably some other types of color prints, Photogard actually somewhat increases the rate of light fading on long-term display. Under high-UV light sources — such as direct sunlight, unfiltered fluorescent light, or direct expo-

A CJ Laser Corporation B-1114 sheet-coater for Photogard. The $12,000 unit, distributed by CPAC, Inc., can handle prints and films up to 11x14 inches. Once Photogard is applied to a print or film, there is no known method for removing the coating without destroying the photograph. If a particle of dirt or lint should become embedded in the coating, it cannot be removed; this is one reason Photogard should not be applied to valuable original films or prints.

A FilmCOAT M7040 strip-coater for applying Photogard to individual rolls or short strips of 35mm and other roll films. Made by CPAC, Inc. and costing about $2,000, the unit is aimed at minilab markets. One worthwhile application of Photogard is to coat scratched negatives; as long as a scratch does not penetrate the image layers of a film, Photogard can reduce or even eliminate the effect of base or emulsion-side scratches when prints are made.

sure in xenon-arc Fadeometers — and if prints are not covered with framing glass or plastic, Photogard will reduce the fading rates of most older color papers. However, for current products such as Ektacolor, Fujicolor, Konica Color, and Agfacolor papers, all of which have an effective UV-absorbing layer over the three image dye layers, Photogard offers little if any additional protection against light fading, even under high-UV display conditions such as direct illumination with bare-bulb fluorescent lamps.

3. Since Photogard contains no solvents, it probably does not reduce or otherwise disrupt the inherent dye stability of chromogenic prints, such those on Ektacolor papers. Currently available lacquers contain solvents and other ingredients that can harm chromogenic prints; damage from lacquers is especially likely to occur if they are applied in thick coats and/or in conditions of high relative humidity.

4. Because neither spotting and retouching colors nor lacquers will properly adhere to the surface of a Photogard coating, all spotting and retouching must be completed before a print is coated. If additional spotting or retouching is necessary after a print has been coated, a new print will have to be made, since Photogard cannot be removed. Portrait and advertising photographers in particular should be aware of this drawback to Photogard.

5. Like lacquers, Photogard will allow prints to be framed directly against glass without a spacing overmat.

6. Photogard offers excellent protection against fungus growth on emulsion surfaces if prints are stored or displayed in humid environments. Typically, fungus becomes a problem when prints are stored for prolonged periods in warm climates with relative humidities above 70%, such as in some southern areas of the U.S. or in the tropics.

7. Photogard is claimed by 3M to reduce dust attraction and other problems associated with static electricity when the relative humidity is low. Simple observation indicates that Photogard does indeed reduce static build-up.

8. Because of the danger of permanently sealing in dust or other dirt on original negatives, transparencies, and motion pictures, and the possibility that Photogard could adversely affect the image stability of these products, Photogard should not be applied to valuable original material.

9. Photogard should not be applied to valuable color or black-and-white RC or fiber-base prints, such as those in museum collections, because of uncertainties about the aging properties of various types of prints coated with Photogard and because of the danger of permanently sealing dust, lint, or other dirt to the surface of the prints. Once applied, Photogard cannot be removed from a print or film by any known method.

Useful Applications for 3M Photogard

Photogard's most valuable characteristics are its abrasion, moisture, and fungus resistance, and its ease of cleaning. Photogard appears to be well suited for roll-coating working copies of microfilms, microfiche, motion picture prints, intermediate motion picture printing negatives, and expendable color negatives (such as those in mass-market portrait and school-picture operations). In addition, a Photogard coating on duplicate slides that are to be distributed to academic slide libraries or similar institutional collections would eliminate the need for expensive glass mounting.

Photogard is also beneficial as a coating for amateur snapshot color prints — with the clear understanding that although the coating offers substantial physical protection to the emulsion of the prints, it will not improve — and may even reduce — the light fading stability of the prints. The fungus protection offered by Photogard is of great value when prints have to be stored or displayed in high-humidity areas, especially in the tropics. Likewise, coating amateur negatives with Photogard can be of substantial benefit in humid areas.

A number of mass-market and school-portrait finishing labs, including School Pictures Inc. of Jackson, Mississippi, treat color negatives with Photogard immediately after processing and drying and have reported that the protection against scratches resulting from rough handling, dust, and static offered by the coating substantially reduces the time required for spotting finished prints. The money saved more than pays for the cost of applying Photogard, even though the negatives are generally disposed of soon after printing.

Notes and References

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3. Eastman Kodak Company, see Note No. 2, p. 41.
4. Eastman Kodak Company, **Preservation of Photographs,** Publication No. F-30, Eastman Kodak Company, Rochester, New York, August 1979, p. 35.
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6. Eastman Kodak Company, **How Post-Processing Treatment Can Affect Image Stability of Prints on Kodak Ektacolor Paper,** Kodak Pamphlet No. CIS-62, Eastman Kodak Company, Rochester, New York, 1982. See also: Eastman Kodak Company, **Conservation of Photographs** (George T. Eaton, editor), Kodak Publication No. F-40, Eastman Kodak Company, Rochester, New York, March 1985, p. 66.
7. Vilia Reed, **Photographic Retouching,** Kodak Publication No. E-97, Eastman Kodak Company, Rochester, New York, August 1987, p. 103. See also: Vilia Reed, **The Fuji Professional Retouching Guide**, Fuji Photo Film U.S.A. Inc., 1992. Instructional videos which cover retouching color negatives and color prints are also available for use in conjunction with the book. Available from Fuji Photo Film U.S.A. Inc., 555 Taxter Road, Elmsford, New York 10523; telephone: 914-789-8201 (toll-free: 800-755-3854).
8. Eastman Kodak Company, **Finishing Prints on Kodak Water-Resistant Papers,** Kodak Publication No. E-67, September 1985, p. 1.
9. Eastman Kodak Company, see Note No. 8, p. 2.
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11. Eastman Kodak Company, **Conservation of Photographs** (George T. Eaton, editor), Kodak Publication No. F-40, March 1985, p. 66.
12. Eastman Kodak Company, see Note No. 11, p. 108.
13. McDonald International, Inc., **Information Sheet on UV Pro-Tecta-Cote Lacquer,** 1982.
14. McDonald International, Inc., "In 10 Years. . .This. . . Or This? Introducing a New UV Pro-Tecta-Cote Lacquer from McDonald," advertisement in **Professional Photographer,** Vol. 109, No. 2045, October 1982.
15. "Color Print Fading is a Hot Topic," advertisement for Sureguard Photo Print Lacquers in **Studio Photography,** Vol. 19, No. 8, August 1983, p. 16. (Sureguard, Inc., Photo Lacquer Division, 2350 114th Street, Grand Prairie, Texas 75050; telephone: 214-647-9049).
16. American National Standards Institute, Inc., **ANSI IT9.9-1990, American National Standard for Imaging Media – Stability of Color Photographic Images – Methods for Measuring**, American National Standards Institute, Inc., 11 West 42nd Street, New York, New York 10036; telephone: 212-642-4900; Fax: 212-302-1286.
17. MACtac products were previously sold under the CoolMount name; MACtac is a division of Morgan Adhesives Company. Permacolor Permagard IP-7000 pressure-sensitive laminate material was used in this author's accelerated tests; the material was obtained in March 1985.
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19. Jack McClintock, "Eye On The Future," **Permaviews,** Spring 1985, published by MACtac Permacolor Division, Morgan Adhesives Company, Stow, Ohio, p. 4.
20. Coda, Inc., Overlam products were among the first pressure-sensitive laminating materials to be marketed for photographs.
21. Ademco-Seal mounting and laminating products are manufactured by Ademco-Seal Ltd., Chester Hall Lane, Basildon, Essex SS14 3BG, England; telephone: 011-44-268-287-650.
22. Ilford Photo Corporation, **Mounting and Laminating Cibachrome [Ilfochrome] Display Print Materials and Films,** (Technical Information Manual), Cat. No. 7929-RMI 895M, 1988. Available from Ilford Photo Corporation, West 70 Century Road, Paramus, New Jersey 07653; telephone: 201-265-2000 (toll-free: 800-631-2522). See also: Remon Hagen, "Further Improvements in the Permanence of Cibachrome Materials Under Adverse Display Conditions," **Journal of Imaging Technology,** Vol. 12, No. 3, June 1986, pp. 160–162.
23. MACtac Permacolor, "UV-Resistance – Accelerated Weathering Tests," **Permaviews,** Winter 1986–1987, published by MACtac Permacolor Division, Morgan Adhesives Company, Stow, Ohio, p. 3. See also: Mike Spidare [MACtac Permacolor], "Cold Mounting Films: A New Era in Image Marketing," Photo Lab Management, Vol. 9, No. 8, August 1987, pp. 59–61.
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26. K-S-H, Inc., **KSH-UVF Picture Saver Panels,** product brochure published in 1982 by K-S-H, Inc., K-S-H Industrial Division, St. Louis, Missouri. (K-S-H, Inc. is now part of ICI Acrylics, Inc., 10091 Manchester Road, St. Louis, Missouri 63122; telephone: 314-966-3111 (toll-free: 800-325-9577). The UV-absorbing polystyrene Picture Saver Panels continue to be sold under the KSH-UVF name.)
27. A. K. Mehta, D. R. Hotchkiss, and J. F. Kistner, "Photogard Technology," presentation at the **International Symposium: The Stability and Preservation of Photographic Images,** sponsored by the Society of Photographic Scientists and Engineers at the Public Archives of Canada, Ottawa, Ontario, Canada, August 31, 1982. As yet, no stability data on color prints coated with Photogard have been published by researchers outside of the 3M Company.
28. CPAC equipment for applying 3M Photogard is sold under the FilmCOAT name; the machines were introduced in 1986. CPAC, Inc., 2364

Leicester Road, Leicester, New York 14481; telephone: 716-382-3223.

29. Nord Photo Engineering (a subsidiary of Photo Control Corporation), 4800 Quebec Avenue North, Minneapolis, Minnesota 55428; telephone: 612-537-7620.
30. CJ Laser Corporation, 3035 Dryden Road, Dayton, Ohio 45439; telephone: 513-269-0513. The firm supplies the B-1114 sheet coater ($12,000) for prints and films in sizes up to 11x14; it can coat about 150 8x10-inch prints per hour.
31. 3M Company, **Duggal Color Projects and Genovese Drug Stores Offer 3M's Photogard Protective Coating,** 3M Company Press Release PH 82-205, November 29, 1982 (For Release: December 2, 1982), p. 2. 3M Photo Color Systems Division, 3M Company, 3M Center, St. Paul, Minnesota.
32. Duggal Color Projects, Inc. (Plaintiff), against Minnesota Mining and Manufacturing Company (Defendant). Case Index No. 4911-84, filed in the Supreme Court of the State of New York in June 1983. A transcript of the case may be obtained from: Supreme Court of the State of New York, County Clerk's Office, 60 Center Street, New York, New York 10007; telephone: 212-374-8300.
33. Baldev Duggal, president, Duggal Color Projects, Inc., telephone discussion with this author, December 11, 1986.
34. 3M Company, "U.V. Fade Study on Kodak Color Paper With and Without Photogard," **3M Data Sheet,** PE-PUVFS-K(52.25)R [1982], Photographic Products Division, 3M, 223-2SE 3M Center, St. Paul, Minnesota 55144. Included in the data sheet: "The minimum benefit of Photogard on Kodak Color Paper [Ektacolor 74 RC], under the conditions tested and using the end point criteria defined, is to extend the paper's life by a factor of 4 (Photogard Factor = 4X). Other factors, such as dark fade and fade in normal light should also be considered in the overall evaluation of fading in color print papers." See also: 3M Company, "U.V. Fade Study on 3M Color Paper With and Without Photogard," **3M Data Sheet,** PE-PUVFS(22.25)R1 [1982]. Graphs from the two 3M data sheets were included in: "3M Protective Coating," **Journal of Applied Photographic Engineering,** Vol. 9, No. 5, October 1983, p. 152A.
35. Ashwani K. Mehta, "Photogard Technology" [synopsis of a presentation at the 128th conference of the Society of Motion Picture and Television Engineers, held October 24–29, 1986 in New York], **SMPTE Journal,** Vol. 96, No. 1, January 1987, p. 131. See also: Martin Hershenson, "Photogard — A Tough Finish For Half-A-Century," **Photographic Processing**, Vol. 22, No. 8, August 1987, pp. 26ff. Apparently quoting 3M test data, Hershenson reported:

    "Photogard has the ability to increase protection against the damage caused by ultra-violet light. (A serious cause of dye fading).

    "Two brands of color paper were incorporated into the test parameters. Accelerated tests were performed for overall stability. In particular, the ever fickle cyan dye came under close scrutiny.

    "The evaluation was done using a xenon arc as the light source, operating in the range of 760 nanometers. The tests would determine how many hours of exposure to so rich a source in UV it would take to reach a 30% dye loss. Brand A color paper when untreated exhibited the loss in only 110 hours. The same brand of paper which had been safeguarded with the protective coating required 600 hours to show the same degree of change.

    "Paper Brand B was also impressive. Here the numbers for the untreated sample were 160 hours of exposure to the xenon arc, as compared with the Photogard coated paper which took over 700 hours to exhibit a 30% dye loss. 3M makes no claims of any improvement in light or dark keeping." (This last statement, apparently a disclaimer offered by 3M, is given without further explanation.)

    See also: Martin Hershenson, "Prints and Slides Protected — 3M Claims its Photogard Process Can Protect Your Originals From Almost Anything . . . Even Hot Chicken Soup!!! Does it Really Work?", **Modern Photography,** Vol. 50, No. 8, August 1986, pp. 24, 80.

Additional References

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Suppliers

3M Home & Commercial Care Division
Bldg. 223-3N-05
3M Center
St. Paul, Minnesota 55144-1000
Telephone: 612-733-6864
(Supplier of 3M Photogard Film and Photo Protector)

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

CJ Laser Corporation
3035 Dryden Road
Dayton, Ohio 45439
Telephone: 513-296-0513

Nord Photo Engineering
4800 Quebec Avenue North
Minneapolis, Minnesota 55428
Telephone: 612-537-7620

MACtac Permacolor
4560 Darrow Road
Stow, Ohio 44224
Telephone: 216-688-1111
Toll-free: 800-323-3439 (outside Ohio)

Coda, Inc.
194 Greenwood Avenue
Midland Park, New Jersey 07432
Telephone: 201-444-7755

Lacquer-Mat Systems, Inc.
1302 East Washington Street
P.O. Box 24
Syracuse, New York 13201
Telephone: 315-471-4037
Toll-free: 800-942-2223

Sureguard Inc.
2350 114th Street
Grand Prairie, Texas 75050
Telephone: 214-647-9049
Toll-free: 800-662-2350 (outside Texas)
(Sureguard Inc. distributes Sureguard-McDonald Pro-Tecta-Cote print lacquers and related products in addition to the firm's line of Sureguard lacquers. Sureguard acquired marketing rights for the McDonald product line in 1989.)