5. Dark Fading and Yellowish Staining of Color Prints, Transparencies, and Negatives

Shortly before his death, Arthur Rothstein visited the Library of Congress where the 8x10 Ansco transparencies are stored on which he shot most of his food assignments. Because of the instability of the emulsion dyes, he said the transparencies had faded beyond recognition or usefulness.[1]

Casey Allen
Technical Photography
April 1988

Once a color photograph has been properly processed, the most important factors in determining the useful life of a color film or color print are the *inherent* dye stability and resistance to stain formation during aging that have been built into the product by its manufacturer. While it is true that even the most unstable materials can be preserved almost indefinitely in humidity-controlled cold storage, only a small fraction of one percent of the many billions of color photographs made around the world each year will ever find their way into a cold storage vault. (In 1990, more than 20 billion photographs were made in the U.S. alone — and of that number, more than 90% percent were shot on color negative film and printed on Kodak Ektacolor paper or similar chromogenic color negative print papers made by Fuji, Konica, or Agfa.[2,3])

Sadly, even many important museums do not yet provide cold storage for their color photograph collections. At the time this book went to press in 1992, the International Museum of Photography at George Eastman House in Rochester, New York, the Metropolitan Museum of Art in New York City, the Corcoran Gallery of Art in Washington, D.C., and the Division of Photographic History at the Smithsonian Institution in Washington, D.C. were among those institutions that did not yet have cold storage facilities. Even the National Geographic Society, which during the years since its founding in 1888 has amassed a large and historically significant color photography collection, stores its photographs without refrigeration in its Washington, D.C. offices. The *National Geographic* magazine, which published its first offset-printed color photograph in the July 1914 issue (the original was an Autochrome plate by Paul Guillamette), was a true pioneer in the publication of photographs in color and in 1920 became the first magazine to have its own in-house color processing laboratory.

Recommendations

See Chapter 1 for a comprehensive list of the longest-lasting color films and print materials, based on overall light fading, dark fading, and dark staining performance.

The vast majority of color photographs are kept in homes and offices under whatever conditions are provided for the people who live or work there. If air conditioning is available — and in most of the world it is not — it is for the comfort of people, and not to prolong the life of photographs. How long a particular color photograph will last depends, more than anything else, on the inherent stability of the film or paper with which it was made. Some materials are *much* more resistant to fading and formation of yellowish stain than others.

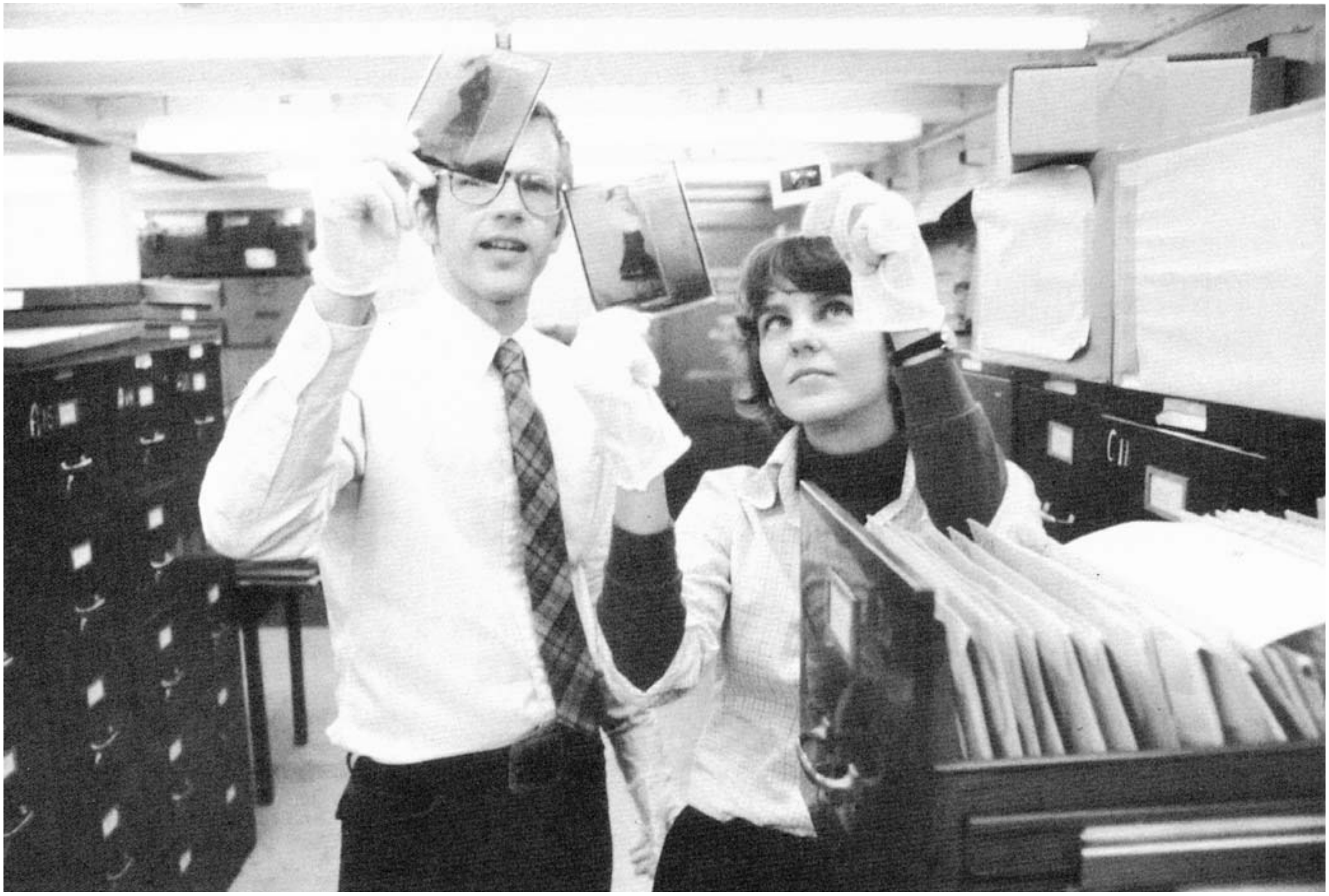
While a photographer must consider many things in selecting a film or print material for a particular application, it only makes good sense to choose the most stable products available from those that otherwise meet the photographer's requirements. For example, Kodak's tungsten-balanced Vericolor II Professional Color Negative Film Type L has a far shorter dark storage life than Fujicolor 160 Professional Film L. Agfacolor XRS 1000 Professional Film is much less stable in dark storage than are Fujicolor Super HG 1600, Kodak Gold 1600, Kodak Ektapress Gold 1600, and Kodak Ektar 1000 films.

Fujichrome Paper Type 35 for printing transparencies is much more stable in dark storage — and when displayed — than Kodak Ektachrome Radiance and Radiance Select papers. Longer-lasting still are Ilford Ilfochrome (called Cibachrome, 1963–1991) polyester-base print materials and color microfilms, the only easily processed color materials on the market that are essentially *permanent* in dark storage (they should last 500 or more years without significant fading or staining when kept in the dark under normal room temperature conditions).

Dark Fading and Staining versus Light-Induced Fading and Staining

This chapter deals with the fading and staining that may occur when color film and print materials are stored in the absence of light — that is, in the dark. (Throughout this book, dark fading and dark staining are often combined under the term *dark fading stability*.) Dark fading of course is not *caused* by darkness (light fading, on the other hand, is caused by light and UV radiation). Dark fading simply refers to the fading and staining that take place in a color material during storage when light is not present.

Given the inherent dark fading stability characteristics of a particular material, the rate of dark fading and staining is determined primarily by the ambient temperature and, usually to a lesser extent with modern materials, by relative humidity. Air pollution and contamination from unsuitable storage materials can also play a part in the deterioration of color photographs, but these factors are usually much less important. (The delicate silver images of black-and-white photographs, on the other hand, can be



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. A wide variety of films dating back to the first Kodachrome films of the mid-1930's are found in the collection. As is the case with most other magazine and picture agency files from this period, many of the transparencies were made on Ansco and Ektachrome films which, because of their very poor dark fading stability in room temperature storage, have suffered substantial image deterioration. (Since this photograph was taken in 1979, the color materials in the **Look** collection have been moved to the library's humidity-controlled cold storage facility in nearby Landover, Maryland.)

extremely sensitive to air pollutants and other environmental contaminants.)

Improper processing of color materials can also impair image stability; for example, use of non-recommended, exhausted, or contaminated chemicals, inadequate washing, omission of the proper stabilizer bath when one is called for, and so forth.

Unless noted otherwise, the data presented in this book are based on careful processing with the manufacturers' recommended chemicals. In the real world of hurried lab production and efforts to keep chemical and wash water costs to a minimum, processing often is less than it should be, and image stability can and does suffer — sometimes catastrophically.

Actually, the slow but inexorable chemical processes involved in "dark fading" and "dark staining" continue whether or not a color photograph is exposed to light on display or during projection. Light fading is a separate process altogether. When a color photograph is exposed to light on display, both light fading and dark fading occur simultaneously. The fading and staining that afflict a photograph over time are in fact a combination of these two basic types of deterioration.

Given the commonly encountered conditions of prints on display, it may be assumed, at least with modern materials, that the fading observed over time has been caused primarily by light. An Ektacolor print, for example, will last far longer when stored in the dark than it will on display. In other words, under normal conditions, the light fading stability of most types of color prints is substantially inferior to their dark fading stability.

Light fading and dark fading also differ in the way that they affect the appearance of the image. In light fading, a disproportionate loss of density occurs in the lower densities and highlights. Visually dark parts of an image can remain more or less intact while lighter areas can become totally washed out. With modern materials, light-induced stain formation (distinguished from light-induced fading) is of less concern when prints are displayed than is staining when the prints are stored in the dark. In dark fading, highlight detail is not lost but an overall color shift occurs, caused by the cyan, magenta, and yellow dyes fading at different rates, and is exacerbated by an ever-increasing level of yellowish stain. In addition, there is both an overall loss of contrast and a discoloration caused by stain that is most objectionable in highlight and low-density areas (see Chapter 2 for further discussion).

A further feature of dark fading versus light fading is that a dye with good stability in the dark may be comparatively unstable when exposed to light. In Kodak Ektacolor papers, for example, the magenta dye is the most stable of the three dyes in the dark, but is the *least* stable in light under typical indoor display conditions.

Improvements Have Been Made in Dark Fading Dye Stability

In the late 1970's, the dark fading stability of both color negative films and papers was so poor that it prompted Ed Scully, in his column in *Modern Photography* magazine, to write:

> Those using color-negative material should know that theirs isn't the most permanent color vehicle. It's bad enough that prints [in albums] are destroyed by leaching polyvinyl chloride, but what's worse is that color negatives will also deteriorate. Those "moments to remember" won't be able to be recaptured unless something's done about them *now*. My recommendation: have reprints made from those negatives you really want, wrap them for freezing in a plastic/foil combination and put them into the freezer. You know, that's a hell of a sad testimony to our photographic technology.[4]

But, as is evident in the product stability tables that follow, significant improvement in the dark fading stability of most types of color print materials has been made during the past 10 years. With the introduction in 1984 of Konica Color PC Paper Type SR (also known as Konica Century Paper), the first of the new generation of chromogenic color negative print papers, Konica achieved an approximately five-fold increase in dark fading stability over the Kodak, Fuji, and Agfa papers available then. Now, in fact, for Ektacolor and Agfacolor papers, it is no longer dye fading but rather yellowish stain formation that is the main image stability problem when the prints are stored in the dark. Fujicolor and Fujichrome papers utilize new types of "low-stain" magenta couplers that afford them much lower rates of stain formation in dark storage than Kodak, Agfa, and most Konica papers.

Most (but not all) color negative and transparency materials have also been improved greatly in terms of dark fading stability. The Kodak Gold Plus color negative films on the market today, for example, are much more stable than the corresponding Kodacolor films of the early 1980's.

These dye stability improvements led Klaus Gerlach of Agfa-Gevaert to say in 1985: "In terms of dye image stability, we consider the dark fading issue as resolved; improvements in light stability are in progress. With our latest generation color paper [stored in the dark] you can still see yourself after 200 years."[5,6] This author does not agree with that assessment. Although you still might be able to see yourself in 200 years if the print is stored in the dark, you won't look very good; fading and staining of the Agfacolor print will be substantial. But Gerlach's point was not completely off the mark — compared with color print papers available for the early 1980's and before, today's color papers have been significantly improved.

It appears likely that further significant improvements in dark storage dye stability and reduction in stain levels can be achieved with chromogenic materials. Recent gains in image stability in Fujichrome Type 35 paper for printing transparencies and Fujicolor Super SFA3 papers for printing color negatives — which this author considers to be by far the best chromogenic papers produced to date — are a major step toward the goal of low-cost chromogenic prints that will remain essentially unchanged after 100 years of being stored in the dark under normal conditions. But a chromogenic print that can retain all of its original brilliance after *100 years of display* is, at least for now, beyond the reach of the photographic industry.

Of Kodak Ektacolor papers, for example, the current Ektacolor Portra II, Ektacolor Supra, Ektacolor Ultra, Ektacolor Edge, and Ektacolor Professional papers have only marginally better light fading stability under normal indoor display conditions than do prints made on Ektacolor 37 RC paper, introduced in 1971. That is more than 20 years with very little progress in light fading stability on the part of Kodak.

In spite of significant light fading stability improvements made by Fuji since 1986 — the light fading stability of the new Fujicolor Super SFA3 chromogenic papers is *much* better than that of Kodak Ektacolor papers — the chromogenic process may never prove adequate for permanent display in museums, public buildings, or homes. Alternative methods of print production (e.g., color pigment prints made by photographic or electrophotographic means, thermal dye transfer prints or ink jet prints with high-stability colorants, or prints made with an improved version of the silver dye-bleach process) may be the only solution to the light fading problem.

In Terms of Dark Fading Stability, the History of Color Materials Is Not Pleasant

The extremely poor dark fading stability, combined with very high levels of yellow-orange stain formation, of all Kodacolor prints produced by Kodak from 1942 until the process was improved in 1953 has resulted in a total loss of the first great era of amateur color prints; this author does not know of a single example of the many millions of Kodacolor prints made during this period that is still in good condition.

For more than 30 years, from 1946 when Ektachrome was introduced until improved Process E-6 films became available in 1976–1977, the Kodak Ektachrome sheet and roll films widely used by professional photographers had extremely poor dark fading stability. Many museum and commercial collections have large numbers of severely faded Process E-1, Process E-2, and Process E-3 Ektachrome transparencies, while most Kodachrome transparencies from this period remain in good condition.

The combination of high temperature and high relative humidity can be particularly devastating to some materi-

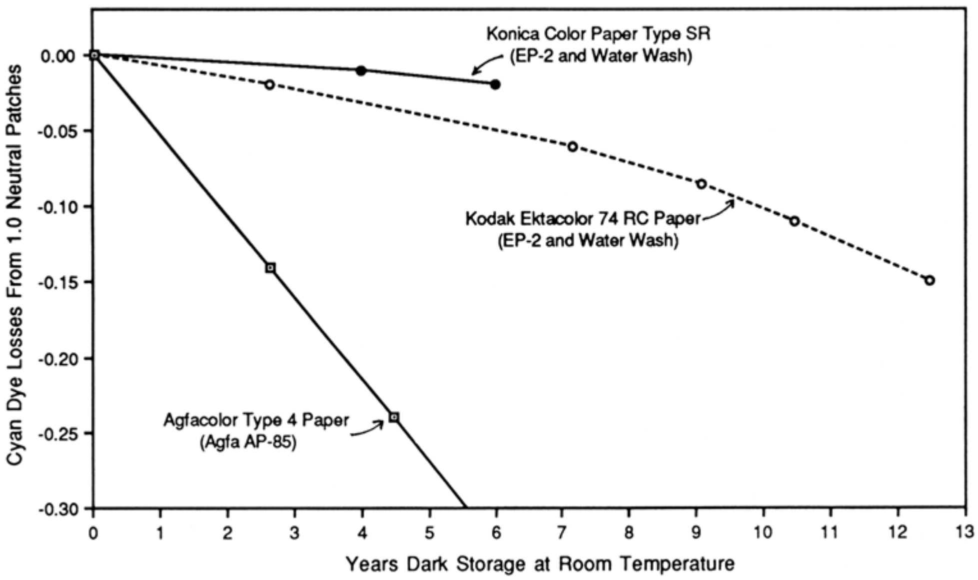


Figure 5.1 In dark storage, the cyan dyes in chromogenic papers traditionally have been the least stable of the three dyes. Cyan dye fading of three papers stored at room temperature (75°F [24°C] and 60% RH) is shown here. Agfacolor Type 4 paper (1974–1982) had extremely poor cyan dye stability, with 20% dye fading occurring in about 4 years when optimally processed and in a much shorter time with commercial processing in many instances. The cyan dye stability of Kodak Ektacolor 74 RC paper (1977–1986) was much better than that of the Agfacolor paper, but not nearly as good as that of Konica Color Type SR (1984—), the first of a new generation of color negative papers with improved cyan dark storage stability.

als, such as the Ansco and GAF transparency films (manufactured from the late 1930's until GAF abandoned the photography business in 1977) and the Agfachrome 64 and 100 films (1976–1983), all of which used the so-called Agfa-type dye-forming couplers.

Prints made in the late 1970's and early 1980's on the now-infamous Agfacolor PE Paper Type 4 have exhibited extremely poor dark fading stability; some Agfacolor PE Paper Type 4 portraits in this author's collection have suffered more than 60% cyan dye loss in less than 4 years of dark storage in an air-conditioned room kept at 70°F (21°C). *The dark fading rate of these prints is so rapid that it can greatly exceed the rate of light fading in normal display conditions.*

Historically, the most widely used chromogenic print materials such as Kodak Ektacolor 37 RC and 74 RC papers have been poor in *both* regards; these prints are doomed to steadily deteriorating color quality whether put on display or kept in an album in the dark (see **Figure 5.1**).

Recommendations of the Best Color Film and Print Materials

Recommendations for the most stable, longest-lasting products in the different categories of film and print materials are given at the beginning of Chapter 1. Other than for color negatives, which normally receive negligible light exposure during printing and are otherwise stored in the dark, these recommendations take into account both light fading and dark fading stability and consider the possible visual significance of yellowish stain formation that occurs during long-term dark storage and/or during or after prolonged display of most chromogenic color materials.

The recommendations are based on this author's short- and long-term accelerated tests, on dark fading data obtained from the manufacturers (which is reported later in this chapter), and on examination of large numbers of color photographs of various types that have been stored and displayed under a wide variety of "normal" conditions in homes, offices, public buildings, and museums and archives.

The light fading stability of color prints is discussed in Chapter 3. Projector-caused fading of color slides (a specific type of very rapid light fading) is covered in Chapter 6. Recommendations for color motion picture films are given in Chapter 9.

Test Methods to Determine Dark Fading and Staining Characteristics of Color Materials

Accelerated test methods for color stability are discussed in detail in Chapter 2, and the reader is advised to consult the sections on accelerated dark fading tests in order to better understand the comparative and predictive tests employed to produce the data reported in this chapter. This author's tests, reported in **Table 5.5a** through **Table 5.9** (pages 180 through 194), are *comparative* tests and were performed according to the general outline described in *ANSI PH1.42-1969, American National Standard Method for Comparing the Color Stabilities of Photographs.*[7] This Standard, which was in effect at the time most of the tests reported here were conducted, has been replaced with *ANSI IT9.9-1990, American National Standard for Imaging Media – Stability of Color Photographic Materials – Method for Measuring.*[8]

In the accelerated dark fading test described in *ANSI PH1.42-1969*, a temperature of 140°F (60°C) and 70% RH are specified. According to the Standard, "This condition is used to simulate results which occur with long-term storage." The Standard also specifies a test at 100°F (37.8°C) and 90% RH to simulate tropical storage conditions.

In this chapter, products are ranked according to the number of days required for a 20% loss of the least stable dye to occur from an initial density of 1.0 when the products are subjected to an accelerated dark storage test at 144°F (62°C) and 45% RH. This is a rather simplistic approach to evaluating the dark storage stability of color materials, but the more complex color balance change and d-min change limits used in the light fading tests in Chapter 3 could not be employed here because, in the case of this author's data, there is considerable uncertainty about the relative rates of dye fading and stain formation in single-temperature tests.

With most chromogenic materials in dark storage, yellowish stain formation can have a profound influence on color balance changes. Most commonly, the stain exaggerates color imbalances that occur between the yellow and cyan or magenta dyes, but sometimes the stain will help make up for, or "mask," a disproportionate loss of yellow dye. In such a situation, a small amount of yellowish stain can, overall, actually be visually beneficial.

To evaluate d-min stain formation, the number of days to reach a d-min color imbalance of 0.10 during accelerated testing, as well as the actual yellowish stain increase after 180 days (6 months) in the tests, are reported in **Tables 5.5a** through **5.7 (pages 180–188),** and in **Table 5.9** (page 193). The d-min color imbalance figures are always followed by the letters "C+Y," which means that the color imbalance occurs on the cyan/yellow axis (that is, between red and blue densities). Note that for both the 20% dye fading data and d-min color imbalance (C+Y) stain data, the greater the number of days required to reach the limit, the more stable is the product. For the 180-day d-min blue density (yellowish stain) increase, however, the *lower* the number, the more resistant to stain is the product.

Condensed versions of many of these tables were published in the June 1990 issue of *Popular Photography* magazine in a cover story by Bob Schwalberg with Carol Brower and this author.[9] This article marked the first time that significant, comparative stability data — including dark storage d-min stain characteristics — had been reported for color photographic products.

Both the manufacturers' data and this author's data that are presented in this chapter are best seen as a beginning effort to compare the image stability of current and past color materials. To give more meaningful evaluations, Arrhenius data must be reported for the full set of image-life parameters specified in Table 9 of *ANSI IT9.9-1990,* preferably for two different relative humidity conditions (e.g., 40% and 60% RH). The light-fading data presented in Chapter 3 and the projector-fading data for color slides given in Chapter 6 are in many respects much more complete.

Because of uncertainties in how data derived from the single-temperature accelerated dark fading tests specified in *ANSI PH1.42-1969* and reported here relate to the actual performance of film and print materials kept under normal storage conditions, the rankings of various products should be considered only approximate when they have fairly close failure times in these accelerated tests. When test data show wider gaps between products, there is reasonable confidence that the more stable one will also be the more stable during long-term storage under normal conditions.

The closer an accelerated test temperature is to actual storage conditions, the more reliable the product rankings will be. The recommended temperature of 140°F (60°C) in *ANSI PH1.42-1969* will produce a 20% density loss of the least stable dyes of most chromogenic products in a year or less; a lower temperature would be better, but test periods would become prohibitively long. In this author's tests, materials with extremely good dark fading stability, such as Ilford Ilfochrome (Cibachrome) and Dye Transfer, have shown negligible fading and, in the case of Ilford Ilfochrome, no measurable staining following a full 9 years of aging at 144°F (62°C) — one can only guess how many years it might take to reach a 20% density loss! Visually, the Cibachrome prints could not be differentiated from prints that had been stored at normal room temperature for 9 years. Even when compared side by side, no fading or color shift could be detected, and no staining whatever occurred, front or back!

Predictive Arrhenius Tests to Evaluate the Dark Storage Stability of Color Materials

The Arrhenius dark storage stability test, specified in *ANSI IT9.9-1990*, is a complex multi-temperature test which allows predictions to be made of the number of years required for specified amounts of dye fading, change in color balance, and stain formation to occur when materials are stored in the dark under normal room temperature and relative humidity conditions (e.g., 75°F [24°C] and 60% RH) or when kept at some other temperature and relative humidity conditions. The Arrhenius test is described in more detail in Chapter 2. At the time this book went to press, this author did not yet have the temperature- and humidity-controlled ovens necessary to conduct Arrhenius tests, but he hoped to acquire the equipment during 1993.

Arrhenius data obtained from the various manufacturers, listed in alphabetical order in **Tables 5.10** through **5.17**, are reported on pages 195 through 209. These predictions are given for a 20% loss of the least stable dye when

ANSI IT9.9-1990, American National Standard for Imaging Media – Stability of Color Photographic Images – Methods for Measuring specifies a predictive, multi-temperature Arrhenius test for evaluating dark storage stability. The Standard also specifies a number of comparative light fading tests for different display conditions.

the film or print material is stored at 75°F (24°C).

Unfortunately, with the exception of Fuji for its low-stain Fujichrome Type 35 and Fujicolor SFA3 papers (and Fuji's earlier Type 34 and Super FA papers), the manufacturers did not disclose predictions for yellowish stain formation, and with many of these products (e.g., Kodak Ektacolor papers) yellowish stain formation is a more serious image stability problem than is dye fading in dark storage. In addition, the manufacturers did not all adopt the same relative humidity level for their tests, and this somewhat limits the comparability of these data.

Dye Fading versus Yellowish Stain Formation

Prior to the introduction in 1984 of Konica Color PC Paper Type SR, with its greatly improved dark storage dye stability, stain formation in chromogenic prints generally had not been a major concern. Until that time, the cyan dyes in color negative papers had such poor dark fading stability that cyan fading, with a resulting color-balance shift toward red, was the weakest link. Now, however, with improvements in dye stability, stain has become a major concern. Particularly with color prints kept in the dark, yellowish stain formation during long-term storage is often visually more objectionable than dye fading itself. Stain robs color images of their sparkle and brilliance, giving them a dull, muddy look.

The current emphasis on stain behavior in dark storage came about in part because in the late 1970's Kodak replaced the final, low-pH stabilizer in the EP-3 process with a somewhat extended wash and renamed it the EP-2 process. EP-3 stabilizer greatly reduced the rate of stain formation in Ektacolor paper in dark storage. Without this stabilizer, Ektacolor Plus and Professional papers processed with EP-2 chemicals and a water wash have a worse stain problem than did the EP-3 processed Ektacolor 37 RC and 74 RC papers of the 1970's.

In a 1985 presentation entitled "Dark Stability of Photographic Color Prints from the Viewpoint of Stain Formation," Kotaro Nakamura, Makoto Umemoto, Nobuo Sakai, and Yoshio Seoka of Fuji Research Laboratories showed that Fujicolor Process EP-2 prints subjected to a short-term accelerated dark fading test exhibited relatively little dye fading, but yellowish stain was quite apparent. The Fuji researchers concluded that Arrhenius tests were valid for predicting the rate of stain formation in normal storage conditions. The authors stated:

> In contrast to the arguments on dark fading, especially on cyan fading, in recent years, the importance of stain generation seems to have been overlooked . . . . The authors think that for extending dark storage life, the problem of yellow stain must be solved.[10]

The principal cause of yellowish stain formation in Ektacolor and other types of chromogenic prints with similar magenta dye couplers has been attributed by Robert J. Tuite of Kodak[11] and others to discoloration of unreacted magenta coupler; the amount of magenta coupler that remains after processing is inversely proportional to the amount of magenta dye present in an image. Kodacolor prints from the 1940's and early 1950's now show this problem to the extreme.

Historically, stain formation during dark storage has been a problem with all chromogenic materials except Kodachrome. (From its inception in 1935, Kodachrome has been an "external-coupler" product in which the color-forming dye couplers are placed in separate cyan, magenta, and yellow developer solutions, instead of being anchored in the film emulsion itself. After processing and washing, no unreacted couplers remain in Kodachrome; for this reason the film remains completely free of stain, even after prolonged storage under adverse conditions.)

Advances have been made, however, and Fujicolor SFA3 and Fujichrome Type 35 papers exhibit markedly reduced levels of stain during aging compared with color papers made by Kodak and Agfa. Most color papers made by Konica still exhibit high stain levels in dark storage; however, in 1990, Konica introduced Konica Color QA Paper Type A5 in Japan, which, like the improved Fuji papers, has significantly reduced rates of yellowish stain formation.[12]

In 1990, Fuji included an Arrhenius projection for dark storage stain formation in a technical brochure for its new Process RA-4 compatible Fujicolor Paper Super FA Type II,[13] and a similar graph for the improved Fujicolor SFA3 papers introduced in 1992 is reproduced here as **Figure 5.2**. Fuji also has published similar data for Fujichrome Paper Type 34 and Type 35 papers.[14]

Fuji is to be praised for publishing this information — the first time a manufacturer has provided such data. The graph shows that, if one were to adopt the stain/color balance limit of 0.1 proposed by this author (see Chapter 2), the stain limit for Fujicolor SFA3 paper would be reached after approximately 45 years of storage at moderate humidity levels, compared with over 100 years for the 20% dye fading limit to occur; in this case cyan is the least stable dye.

Figure 5.3 shows the reduction in yellowish stain achieved in Konica Color QA Paper Type A5, introduced in Japanese markets in 1990, when compared with Konica Color QA Paper Type A2. (With respect to stain, Konica Type A3 paper is similar to Konica Type A2 paper.)

As part of his long-term testing program, this author periodically measures the fading and staining of color paper samples kept in the dark under normal room temperature storage conditions of 75°F (24°C) and 60% RH. That most color papers do indeed develop significant levels of yellowish stain in normal, non-accelerated storage is clearly evident in **Figure 5.4**. Kodak Ektacolor Plus and Professional papers and Agfacolor Type 8 paper (all EP-2 papers) had reached this author's critical "Museum and Archive" limit in less than 4 years. This author's more tolerant "Home and Commercial" d-min color imbalance limit for these papers will probably be reached in less than 15 years.

Figure 5.5 shows the yellowish stain increase for a number of RA-4 color papers in this author's single-temperature accelerated test at 45% RH. The superiority of the "low-stain" Fujicolor Super FA papers is clearly evident in this comparison.

In all cases with chromogenic papers, high relative humidity in the storage environment significantly increases the rates of yellowish stain formation (see **Figure 5.6**).

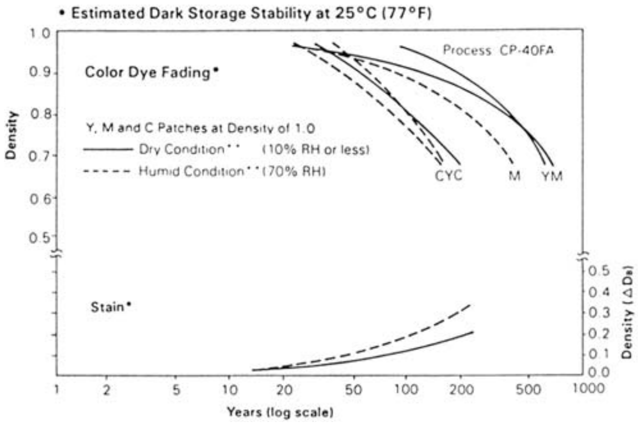


Figure 5.2 An Arrhenius plot for Fujicolor Paper Super FA Type 3 (one of Fuji's SFA3 papers), introduced in 1992, showing both dye fading and d-min yellowish stain formation. Predictions are given for storage in the dark at 77°F (25°C) and 70% RH and in very dry (<10% RH) conditions. Both stain formation and dye fading, especially yellow dye fading, are significantly increased by high relative humidity. Fujicolor SFA3 papers and Fujichrome Type 34 and 35 papers employ new types of "low-stain" magenta dye couplers, and these products have much lower stain levels in dark storage than competing papers made by Kodak and Agfa. (Fuji data from: **Fujicolor Paper Super FA Type 3**, Fuji Publication No. AF3–723E, January 1992. Reproduced with permission.)

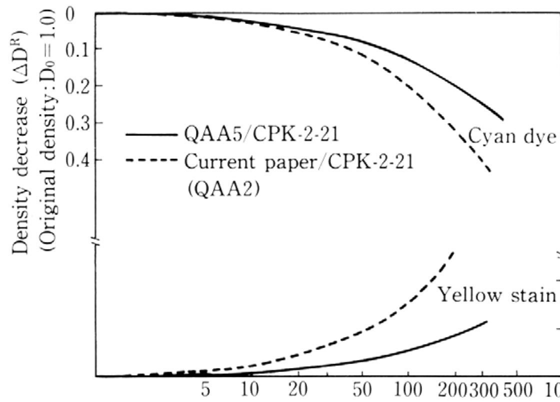


Figure 5.3 An Arrhenius plot for Konica Color QA Paper Type A5 (QA A5 paper) showing both dye fading and d-min yellowish stain formation. Predictions are given for storage in the dark at 75°F (24°C) and 60% RH. Compared with Konica Type A2 and Type A3 papers (QA A2 and QA A3), the rate of yellowish stain formation has been considerably reduced. Type A5 paper, which was introduced in Japanese markets in 1990, is the first Konica paper to utilize a "low-stain" magenta coupler. (Konica data from: "The Development of Konica QA Paper Type A5," **Konica Technical Report**, Vol. 5, January 1992, pp. 25–29. Reproduced with permission.)

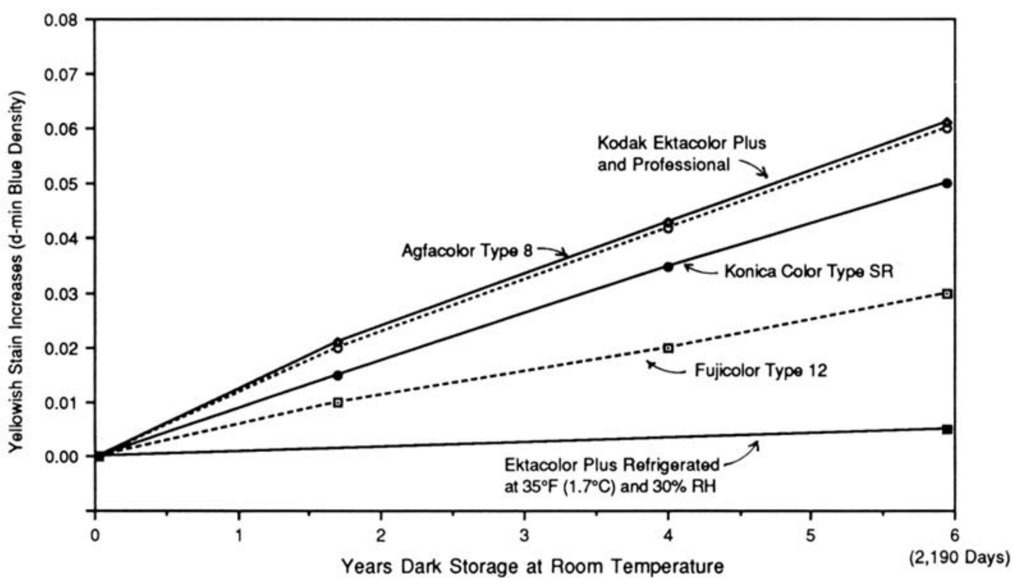


Figure 5.4 Yellowish stain formation in room-temperature dark storage (75°F [24°C] and 60% RH) was significantly reduced in Fujicolor Paper Type 12, introduced in 1985, and available primarily in Japanese markets. This was the first color negative paper to employ improved, "low-stain" magenta dye couplers. Long-term, room-temperature data are not yet available for Fujicolor SFA3 papers introduced in 1992, but accelerated aging data indicate that the rates of stain formation are as low or lower for these papers.

As shown in **Figure 5.7**, yellowish stain formation in dark storage usually has a pronounced effect on perceived color balance; the effect is visually most apparent in low-density areas of an image (e.g., at densities below 0.5).

Although dye stability **Tables 5.5a** through **5.7** and **Table 5.9** include stain-formation data, insufficient information is available to use these data with any assurance as part of the ranking of products given in this book. Likewise, evaluation of color imbalances could not be done. At this stage, it is simply not possible to evaluate color prints and transparencies for dark fading and staining with the full set of image-quality criteria used to rank color prints for light fading stability in Chapter 3. For the same reason (with the exception of the data published by Fuji for Fujicolor SFA3 papers and Fujichrome Type 35 papers), the absence of Arrhenius stain data from Kodak, Agfa, Konica, and 3M has precluded stain growth and color imbalance as major considerations in evaluating Arrhenius storage-life predictions by these companies.

What information is available, however, strongly sug-

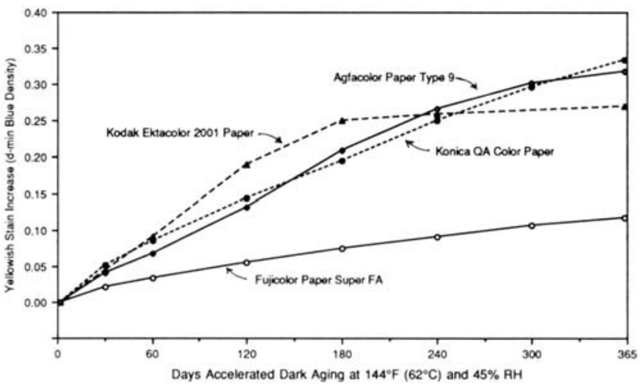


Figure 5.5 A comparison of yellowish stain formation in four Process RA-4 compatible papers in an accelerated dark storage test conducted at 144°F (62°C) and 45% RH. All of the papers were processed with the manufacturers' chemicals in "washless" minilabs using a stabilizer as the final rinse. The substantial reduction of yellowish stain in Fujicolor Super FA and SFA3 papers is one benefit of the new "low-stain" magenta coupler employed by Fuji in the new papers. In addition to reducing stain, the new coupler produces magenta dye with better color purity and far better light fading stability than the magenta dye in Kodak Ektacolor and other color negative papers.

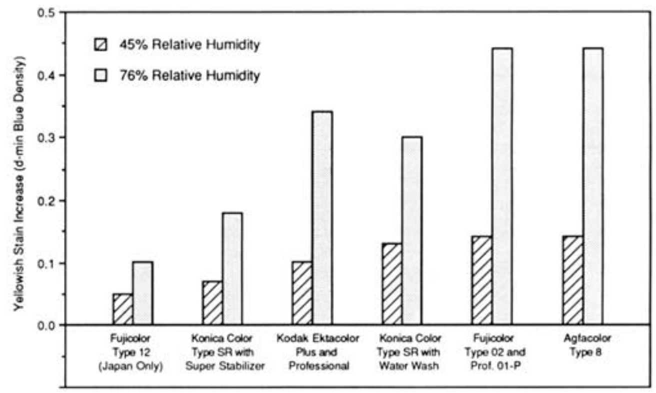


Figure 5.6 Stain formation of six Process EP-2 compatible papers in an accelerated dark aging test at 144°F (62°C). Data are given for 45% RH and 76% RH. The superiority of Fujicolor Paper Type 12 (1985—) processed with a water wash is readily apparent. This paper employs a "low-stain" magenta coupler and was the first Fuji paper to incorporate this major improvement.

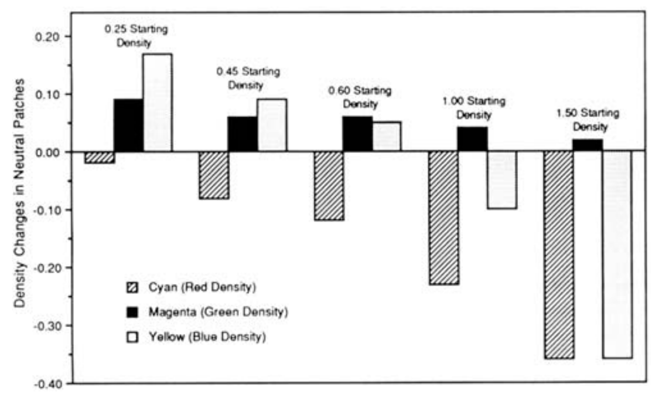


Figure 5.7 Color balance changes in chromogenic papers result from a combination of image dye fading and yellowish stain formation. As shown in this accelerated aging test at 144°F (62°C) and 45% RH, the effect of stain on Ektacolor 2001 Paper (1986–91) is most pronounced at low densities and in d-min areas (Ektacolor Portra II and other Ektacolor papers have similar stain characteristics). With typical pictorial scenes, a density of about 0.6 (about 0.5 above d-min) is the most critical in terms of color balance changes.

gests that many of the predictions of dark storage print life published by Kodak and other manufacturers that have omitted yellowish stain behavior, both in and of itself and with respect to the influence of stain on color balance changes, are too optimistic.

Kodak certainly recognizes that clear, bright "whites" are an important aspect of print quality. In a 1992 advertisement for Ektacolor Edge paper that appeared in *Photographic Processing* magazine and other trade publications, Kodak said:[15]

> When it comes to building your business, new Kodak Ektacolor Edge paper delivers cutting-edge advantages. It features a new, larger backprint for greater brand identity, plus sharp color and "whiter" whites created by improved, fresh D-min characteristics.

Like other advertisements for Ektacolor and Ektachrome papers, nothing was said about the d-min staining characteristics of the papers during storage and display.

Two methods can help reduce stain in chromogenic materials. One approach is to do what is done in "washless" minilabs and add a stain-reducing stabilizer to the standard water-wash EP-2 and RA-4 processes — in other words, return to EP-3 (with a new stabilizer designed specifically for current papers). The third processing bath would cost little and would probably reduce water consumption, but this approach has a major drawback in that current water-wash processors would have to be modified to accommodate the stabilizer bath, and processing time would be increased.

It is unlikely that most large photofinishers and custom processing labs would readily make this change. A further drawback is that low-pH stabilizers such as EP-3, which are effective in reducing dark-storage stain (see **Table 5.1**), also tend to reduce the light fading stability of the yellow dye in chromogenic color papers (see Chapter 2).

EP-3 stabilizer should NOT be used on Ektacolor Plus or other current papers; to do so may have an adverse effect on dark and/or light fading stability, particularly of the yellow dye. Only stabilizers specifically recommended by a paper or film manufacturer for its particular products should be used. For example, do not use Konica Super Stabilizer with Ektacolor papers. At present, EP-2 or RA-4 "process-compatibility" does not extend to washless stabilizers.

The second approach to reducing yellowish stain is to employ new types of "low-stain" magenta couplers, as Fuji has done with Fujicolor SFA3 color negative papers and Fujichrome Type 35 reversal papers.[16] (As mentioned earlier, unreacted magenta couplers that remain in a chromogenic paper after processing are the principal source of yellowish stain that forms over time.)

Fujicolor Paper Type 12, introduced in 1985, primarily in Japanese markets, and Fujichrome Paper Type 34, introduced in 1986, were the first chromogenic papers to employ low-stain magenta couplers.[17] Konica has also utilized a low-stain magenta coupler in Konica Color QA Paper Type A5, introduced in Japan in 1990. This is really the only satisfactory solution to the stain problem because the Fujicolor, Fujichrome, and Konica Color papers either may be given a water wash following processing or may be treated with a "washless" stabilizer as a final rinse, as is now usually the case in minilabs. Furthermore, the reduction in stain levels afforded by the new low-stain magenta couplers is significantly greater than that of papers with conventional magenta couplers processed with EP-3 stabilizer or a similar, low-pH stabilizer.

The coupler technology, dye stability, reduction in stain level, and improvements in color reproduction in Fujicolor Super FA papers have been described in a 1990 paper entitled "New Type Color Print Paper with an Improved Color Saturation and Dye Image Stability — Fujicolor Paper Super FA," by O. Takahashi, T. Sato, K. Hasebe, N. Furutachi, and T. Ogawa,[18] and in a 1992 paper entitled "New Type Color Paper with Exceptional Dye Image Stability — Fujicolor Paper Super FA Type 3",[19] by Tadahisa Sato, Masakazu Morigaki, and Osamu Takahashi.

The "low-stain" coupler technology and other improvements in Konica Type A5 paper have been described by Makoto Kajiwara, Toyoki Nishijima, and Noboru Mizukura in a report entitled "The Development of Konica QA Paper Type A5," published by Konica in 1992.[20]

The magenta dyes produced by the new magenta dye-forming couplers in current Fujicolor SFA3 papers for printing color negatives (and Fujichrome Type 35 papers for color transparencies) have significantly better light fading stability and also have better reproduction of reds, purples, pinks, and blues than do the older types of magenta dyes found in Ektacolor, Ektachrome, and most other papers.

Processing of Test Samples

When Kodak, Fuji, and other manufacturers test their products, they use samples that have received optimum processing and thorough washing under carefully controlled laboratory conditions. This is done to show the products to their best advantage and to ensure that tests will be repeatable over time (that is, to eliminate processing variations as a consideration).

In the real world of replenished processing lines, hurried lab schedules, and efforts to keep chemical and water costs to a minimum, things frequently do not turn out so well. In some cases, as shown in **Figure 5.8**, processing shortcomings can have disastrous effects on image stability.

In recent years, a number of companies have entered the photographic processing chemicals market, generally supplying chemicals at lower cost than do Kodak, Fuji,

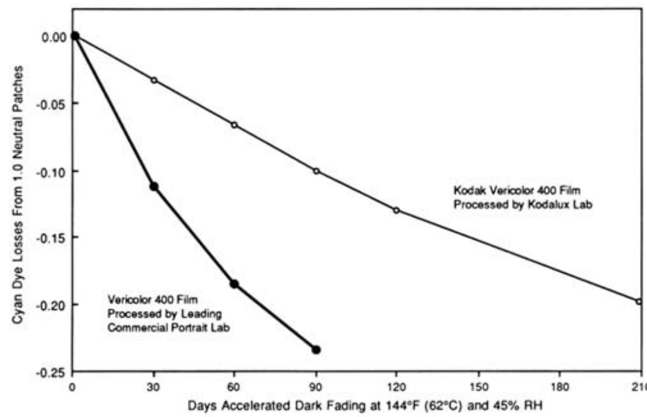


Figure 5.8 Processing shortcomings can have an adverse effect on dye stability and on rates of yellowish stain formation. In this example, the cyan dye in Kodak Vericolor 400 (a Process C-41 color negative film) had much worse stability when the film was processed by a leading commercial and portrait lab located in the southwestern U.S. than the same film did when processed by the Qualex Kodalux lab in Findley, Ohio.

Agfa, and Konica. What effects processing chemicals from these outside suppliers might have on long-term image stability are not known. Some suppliers, in an effort to shorten processing times or reduce the number of processing steps, have substituted color developing agents, eliminated stabilizer baths in the C-41 and E-6 processes, and taken other shortcuts that adversely affect stability. For predictable results, it is recommended that only chemicals from Kodak, Fuji, Agfa, and Konica be used. Processing recommendations, replenishment rates, wash flow, and temperature specifications should be followed to the letter.

Most labs try to retain tight control on color developer activity — that is, to reduce any process deviation resulting in image-quality losses that can be visually assessed immediately after processing. But other processing problems, such as too-diluted (or omitted) C-41 or E-6 stabilizer baths, excess bleach-fix carryover, or inadequate washing, may not manifest themselves until months or years later.

The photograph studio at the Metropolitan Museum of Art in New York City discovered rapid and irregular magenta dye fading in a large number of Ektachrome transparencies processed by an outside lab in New York between 1982 and 1987.[21] The transparencies, most of which were in the 8x10-inch format, were of paintings, sculptures, and other artifacts in the museum's collections and had looked perfect when they were received from the lab. (The Metropolitan's photograph studio is a large operation that produces between 3,000 and 5,000 large-format color transparencies a year.) Many other Ektachromes from the same period have not faded prematurely, and none processed before 1982 exhibit the problem; all were stored in the dark under the same conditions.

After investigation, the cause of the premature and irregular fading and streaking was attributed to low solution level in the E-6 stabilizer tank in the processor or, possibly in some cases, omission of the stabilizer altogether.

In an attempt to represent the real world of good-quality, replenished-line processing, all C-41 color negative films, E-6 transparency films, and Kodachrome films in this author's testing program were processed by the Kodalux Processing Services of Qualex, Inc. (see Chapter 2). Eastman Kodak owns almost half of Qualex (the former Kodak Processing Laboratories are now part of Qualex), and Kodak chemicals are used exclusively. Because of Kodak's close involvement with Qualex, it was assumed that the labs pay careful attention to process control, and the consistency of stability data obtained from the same type of film processed at different times by Kodalux suggests that this is, at least for the most part, true.

In order to obtain closely matched pictorial prints for reproduction in this book, for use in articles,[22] and for corresponding Macbeth ColorChecker test samples for acquiring densitometer data, EP-2 and R-3 papers were processed by this author with Kodak chemicals and a Kodak Rapid Color Processor Model 11 fitted with a precise electronic temperature regulator (see Chapter 2). Each test print was made with fresh chemicals (Kodak Ektaprint EP-2 Stop Bath was included between the developer and bleach-fix), and the prints were properly washed.

Processed Cibachrome samples were furnished by Ilford in Switzerland, and additional samples were processed by this author. Kodak Dye Transfer prints were made in several different New York City labs. Fuji Dyecolor prints were supplied by Fuji. UltraStable Permanent Color prints and Polaroid Permanent-Color prints were supplied by Charles Berger, the inventor of both processes.

Konica, Fuji, and Agfa RA-4 compatible paper samples were processed under carefully controlled conditions by their respective manufacturers from test negatives furnished by this author. In most cases, prints processed with a water wash and duplicate prints processed with the particular manufacturer's washless stabilizer were supplied. Kodak declined to furnish samples of processed Ektacolor RA-4 prints, so prints made with Ektacolor Portra, Portra II, and Supra papers were obtained from several leading commercial labs. In addition, samples of Ektacolor 2001 paper were obtained from a number of 1-hour labs using Kodak minilabs and Kodak RA-4 chemicals.

Exactly what constitutes "typical" or "normal" processing cannot be answered at this time. Also unknown is how the stability of each of the vast number of different film and print materials on the market is affected by different types of processing chemicals and by process deviations (some are obviously more sensitive to improper processing than are others). Both cyan dye stability and yellowish stain formation during dark storage appear to be particularly affected by processing and washing conditions. A sobering study in this regard was presented in 1986 by Ubbo T. Wernicke of Agfa-Gevaert, entitled "Impact of Modern High-Speed and Washless Processing on the Dye Stability of Different Colour Papers."[23]

Dark Fading and Staining of Color Negative Print Papers

In terms of market share, chromogenic papers for printing color negatives are by far the most significant type of color print material. Current Process RA-4 compatible color negative papers are listed in **Table 5.5a** (**page 180**).

Clearly the best of the current RA-4 papers are the Fujicolor SFA3 papers introduced in 1992. Of special importance to portrait and wedding labs is Fujicolor SFA3 Professional Portrait Paper (tentative name), which Fuji planned to make available in the U.S. during 1993. The light fading stability of the Fujicolor papers are unsurpassed among color negative papers, and the resistance of the papers to dark fading and dark storage yellowish stain formation is equalled only by Konica Color QA Paper Type A5.

But unlike Konica Type A5 paper and most of the other color papers tested by this author, the rates of dye fading and yellowish stain formation of the Fujicolor SFA3 papers in dark storage were almost identical when the prints were given a water wash or when they were treated with the recommended stabilizer in a washless process.

In this author's dark fading tests, the overall dye stability of Kodak Ektacolor Portra II Paper was better than that of other current Ektacolor papers and the previous Portra paper (in the single-temperature, 45% RH tests, the yellow dye and the previously less stable cyan dye had almost identical stability). Unfortunately, however, Portra II proved to have the same unacceptably high rates of yellowish stain formation in dark storage found in Portra and other Ektacolor papers. In addition, the poor light fading stability of Portra II paper remains unchanged and is no match for the much longer lasting Fujicolor SFA3 papers.

Current Process EP-2 compatible color negative papers are listed in **Table 5.5b** (page 181), with obsolete products listed in **Table 5.5c** (page 183). A comparison of the pre-1984 materials in **Table 5.5c** with current materials clearly shows the dramatic improvements in dye stability in most products that began with the introduction in 1984 of Konica Color PC Paper Type SR (also called Konica "Century Paper"). A Konica ad for the new paper appearing in *Professional Photographer* magazine read in part:

> Prints made on paper currently available will fade, and badly, over a relatively few years. *Not so with color prints made on Konica SR Paper.* The rich color and details in these pictures will show virtually no signs of fading in 100 years. Our advanced emulsion technology enhances dye stability. In fact, accelerated aging tests show that dye images will retain more than 70% of their original density for 100 years or longer under normal album storage conditions.[24]

A few months after the introduction of Konica Type SR paper, Kodak followed with Ektacolor Plus Paper, a similar EP-2 product having a cyan dye with improved stability. Konica Type SR paper is even better when processed in the "washless" mode with Konica washless stabilizer; stain levels are greatly reduced with the stabilizer. Type SR paper is superior to Kodak Ektacolor Plus and Professional papers in both dark fading and light fading, and for this reason it is the recommended EP-2 product.

When Ektacolor Plus paper is processed in KIS Ultra X Press chemicals, substituting CD-4 developing agent for the normal CD-3 developing agent to increase the speed of processing, a significant reduction in both light and dark fading stability occurs; for this reason the KIS process should be avoided.

Table 5.1 Comparison of Plain Water Wash and Final Treatment in Kodak Ektaprint 3 Stabilizer on the Dark Fading and Staining Behaviors of Selected Process EP-2 Compatible Papers for Printing Color Negatives

Accelerated Dark Fading Tests at 144°F (62°C) and 45% RH

Boldface Type indicates products that were being marketed in the U.S. and/or other countries when this book went to press in 1992; the other products listed had either been discontinued or replaced with newer materials. Initial neutral density of 1.0 with ½ d-min corrected densitometry.

	Plain Water Wash		Final Treatment in Kodak Ektaprint 3 Stabilizer	
Type of Color Print Paper	Days for 20% Loss of Image Dye	Stain Increase After 90 Days	Days for 20% Loss of Image Dye	Stain Increase After 90 Days
Agfacolor Paper Type 8 [improved]	**370 (–C)**		**365 (–C)**	
Agfacolor Paper Type 8 ML	**>500 (–M)**		**>500 (–M)**	
	355 (–Y)	**+0.11Y**	**170 (–Y)**	**+0.07Y**
Konica Color PC Paper Type SR	**300 (–C)**		**365 (–C)**	
Konica Color Paper Professional	**>500 (–M)**		**>500 (–M)**	
Type EX	**>500 (–Y)**	**+0.13Y**	**>500 (–Y)**	**+0.07Y**
Mitsubishi Color Paper KER Type 6000 Super				
Mitsubishi Color Paper KER Type 8000 Pro				
Kodak Ektacolor Plus Paper	**230 (–C)**		**260 (–C)**	
Kodak Ektacolor Prof. Paper	**>500 (–M)**		**500 (–M)**	
	>480 (–Y)	**+0.12Y**	**140 (–Y)**	**+0.07Y**
Fujicolor Paper Type 02	155 (–C)		230 (–C)	
Fujicolor Professional Paper	>500 (–M)		>500 (–M)	
Type 01-P	>500 (–Y)	+0.14Y	175 (–Y)	+0.07Y
Fujicolor Paper Type 12	**130 (–C)**		**180 (–C)**	
Fujicolor "Minilab Paper"	**>500 (–M)**		**>500 (–M)**	
	>500 (–Y)	**+0.07Y**	**190 (–Y)**	**+0.04Y**
Fujicolor Paper Type 8908	55 (–C)	+0.23Y	115 (–C)	+0.06Y
Konica Color (Sakuracolor) PC Paper SIII	50 (–C)	+0.14Y	95 (–C)	+0.08Y
Kodak Ektacolor 74 RC Paper Type 2524	36 (–C)	+0.11Y	60 (–C)	+0.09Y
Kodak Ektacolor 78 Paper Type 2524				
Kodak Ektacolor 37 RC Paper Type 2261	31 (–C)	+0.16Y	52 (–C)	+0.10Y
Kodak Ektacolor 74 RC Paper	27 (–C)	+0.14Y	52 (–C)	+0.08Y

The Effects of Low-pH EP-3 Stabilizer on the Dark Fading Stability of Process EP-2 Prints

In a series of experiments to determine the effects on dark storage stability of a "generic" low-pH stabilizer, this author treated various papers with the now-obsolete Kodak Ektaprint EP-3 stabilizer after washing. The results of these tests are shown in **Table 5.1**. The stabilizer increased cyan dye stability and at the same time reduced stain levels in all of the older papers; with current papers, however, all products except Konica Type SR paper suffered a marked reduction in yellow dye stability. Konica Type SR paper showed an even greater reduction in stain when processed with Konica Super Stabilizer (see **Figure 5.9**). With the exception of Type SR paper, all of the EP-2 papers tested — including Ektacolor Plus and Ektacolor Professional papers — also exhibited significantly increased yellow dye fading in low-level, long-term light fading tests.

Stability of Papers for Printing Color Transparencies

Most of the products listed in **Table 5.6** (page 185) are intended for printing from color transparencies; the Polaroid Permanent-Color , UltraStable Permanent Color, and EverColor pigment color processes along with the Kodak Dye Transfer process can also be used to make prints from color negatives or to make copies of existing prints. When compared with even the best of the chromogenic papers, the dark storage superiority of the preformed-dye systems, as exemplified by Ilfochrome (called Cibachrome, 1963-91), is clearly evident in this table and in **Table 5.12** (page 193). The preformed-dye products have extremely good dark fading stability and develop little or no stain. A comparison between Ilfochrome and Kodak Ektachrome Copy Paper (introduced in 1984 and still on the market at the time this book went to press in 1992) and the initial version of Ektachrome 22 Paper (1984–91) is a study in extremes.

Among the Process R-3 compatible papers, the Fujichrome Type 35 papers are clearly the longest lasting, both in terms of dye stability and resistance to stain formation. The Fujichrome papers are greatly superior to Kodak's Ektachrome Radiance and Radiance Select papers.

Fujichrome Type 35 paper was introduced in 1992 as a replacement for Type

34 paper. There was not enough time to complete tests on the new Type 35 paper before this book went to press. However, Fuji has informed this author that the dye stability and resistance to yellowish stain of Type 34 and Type 35 papers are identical (the improvements in Type 35 paper had to do with color and tone reproduction, and did not affect image stability). For this reason, the data given for Type 34 and Type 35 papers in **Table 5.6** are identical.

When this book went to press in 1992, Ektachrome Copy Paper still employed one of the pre-1984 types of highly unstable cyan dyes that does not approach the stability of the cyan dye in Fujichrome Type 34 and Type 35 papers.

Instant Color Prints and Thermal Dye Transfer, Ink Jet, and Other Print Processes for Digitized and Computer-Generated Images

As shown in **Table 5.7** (page 187), the dyes in Polaroid instant prints are extremely stable in dark storage. However, when discussing the stability of Polaroid SX-70, Spectra, and Polaroid 600 Plus prints, dark storage dye stability is only part of the story. The problem with these prints is that in dark storage at normal temperatures they develop an objectionable overall yellowish stain in a relatively short time. In non-accelerated, real-time tests, the stain levels exceeded this author's limits in only a few years (see **Table 5.2** and **Figure 5.10**). The stain is produced by slow migration of non-image dyes and/or other chemical constituents residing in the lower layers of the tightly sealed Polaroid print package.

Table 5.2 Stain Formation in Polaroid Spectra Prints and Other Polaroid Integral Instant Color Prints Stored in the Dark at Normal Room Temperature and Relative Humidity Conditions

Initial Densitometry: 24 Hours After Processing
Test Duration of Up to 10 Years (3,650 Days)

Boldface Type indicates products that were being marketed in the U.S. and/or other countries when this book went to press in 1992.

Type of Print	Days to Reach "Museum" d-min Color Imbalance Limit	Years to Reach "Commercial" d-min Color Imbalance Limit
Polaroid Spectra Prints (1986–91) Polaroid Image Prints (Spectra in Europe) **Polaroid 600 Plus Prints** (1988—) **Polaroid Type 990 Prints** **Polaroid Autofilm Type 330 Prints**	**16 (C+Y)**	**3.0 (C+Y)**
Polaroid High Speed Type 779 Prints **Polaroid Autofilm Type 339 Prints** Polaroid 600 High Speed Prints (1980–88)	**12 (C+Y)**	**0.3 (C+Y)**
Polaroid SX-70 Time-Zero Film (1979—) **Polaroid Type 778 Time-Zero Prints**	**32 (C+Y)**	**0.4 (C+Y)**
Polaroid SX-70 Film [improved] (1976–79)	31 (C+Y)	>10.0 (C+Y)

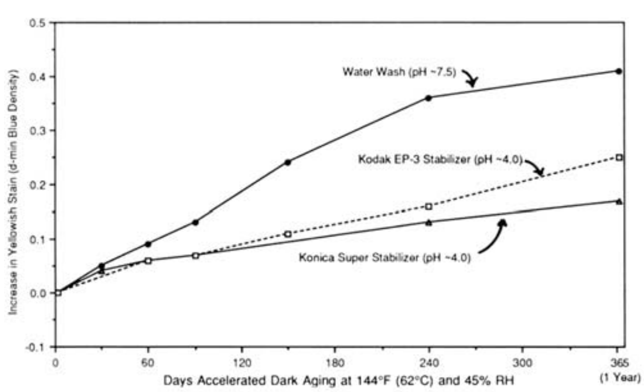


Figure 5.9 Yellowish stain formation in Konica Color PC Paper Type SR prints is similar when they are processed with Kodak EP-3 Stabilizer or with Konica Super Stabilizer. In common with other Process EP-2 compatible papers, Type SR paper has a significantly higher stain rate when a final water wash is employed in place of a low-pH stabilizer.

In 1991, Polaroid introduced a sharper and finer-grain Spectra film called Spectra High Definition film (Spectra HD film); however, a company official informed this author that the new film was not markedly improved in terms of its tendency to form yellowish stain in dark storage.

In 1992, Polaroid introduced the Vision 95 system in Europe, a smaller format camera and film employing an improved version of the Spectra HD print emulsion. In 1993, "Vision 95" cameras and film will be introduced in the United States and other parts of the world under different names. A Polaroid spokesman told this author that Vision 95 film has somewhat reduced rates of yellowish staining in dark storage; however, specific stain data for Vision 95 prints were not available from Polaroid or independent laboratories at the time this book went to press.

Polaroid Spectra and Polaroid 600 Plus prints have poor light fading stability. When displayed, these prints fade significantly faster than typical chromogenic papers. Polaroid color prints have no usable negative (like daguerreotypes, each exposure produces a unique image). If important pictures have been made on these materials, the best policy is to make two copies on a more stable print material. (Polaroid itself offers good-quality copies made on chromogenic paper at reasonable cost.) One of these copies should be kept in the dark and the other may be displayed.

Polaroid peel-apart prints (e.g., Polacolor ER and Polacolor 2) last much longer in dark storage than Spectra and other Polaroid integral prints because the negative layer with its unused image-forming dyes and other chemicals is

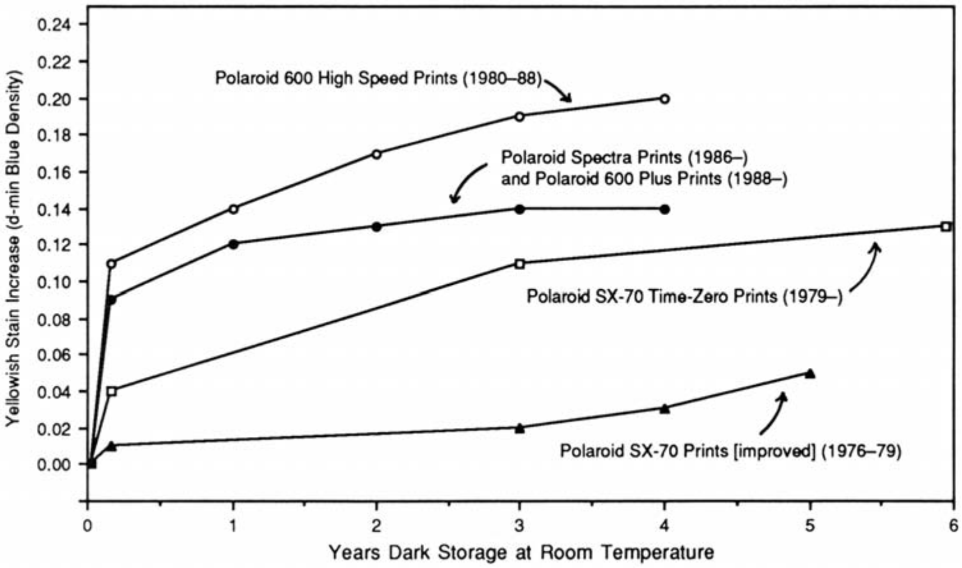


Figure 5.10 Polaroid Spectra and other Polaroid integral instant color films develop significant yellowish stain during normal, room-temperature storage at 75°F (62°C) and 60% RH. Earlier Polaroid SX-70 [improved type] prints exhibited much lower stain levels. The sharper and finer-grain Spectra HD film introduced in 1991 is reported by Polaroid to have yellowish stain characteristics that are similar to the earlier Spectra film.

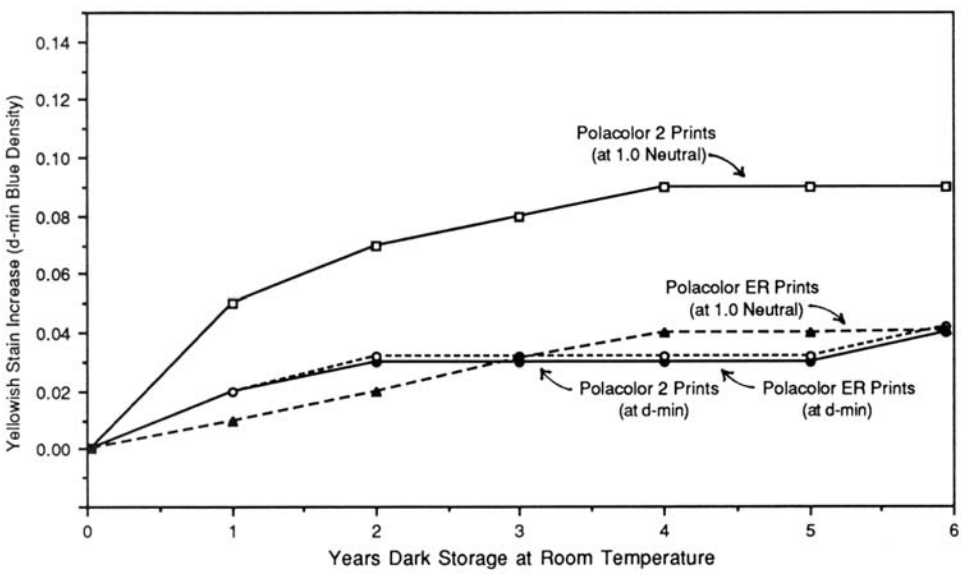


Figure 5.11 Polaroid Polacolor 2 and Polacolor ER peel-apart prints have generally better stain characteristics than Polaroid integral prints. With Polacolor 2 prints, higher levels of stain occurred at higher image densities (e.g., 1.0) than at d-min, and this resulted in a yellowish color-balance shift that was readily visible.

stripped away after processing (see **Figure 5.11**). Polacolor 2 prints, however, may exhibit pronounced color balance shifts in higher density areas of the image, despite relatively little change at d-min.

Polacolor ER and Polacolor 2 peel-apart prints have poor light fading stability and should be displayed with caution. Copies should be made for long-term display.

Kodak Ektatherm thermal dye transfer prints did not do well in these dark fading tests. When the Kodak Photo CD system was commercially introduced in the summer of 1992, Ektatherm prints were the only type of print initially available for reproducing images from Kodak Photo CD's. The Photo CD Index Print supplied with each Kodak Photo CD as a "contact sheet" for visual reference to the images recorded on the Photo CD was also an Ektatherm print.

Kodak declined to supply Arrhenius data for Ektatherm prints, and it is not known whether these prints undergo abnormally rapid image deterioration when subjected to high-temperature accelerated tests. There is concern that when thermal dye transfer materials are subjected to sustained temperatures above a certain point, the image dyes may migrate or undergo physical changes within the structure of the print in a manner that will never occur at more moderate temperatures.

Preliminary tests with high-resolution color ink jet prints made with ink sets supplied by Iris Graphics, Inc. and Stork Bedford B.V. indicate that the prints have extremely good dark storage stability with no tendency to form yellowish stain if they are made on stable support materials. However, as discussed in Chapter 3, the light fading stability of the ink sets supplied by these two manufacturers at the time this book went to press in 1992 was very poor.

One reassuring finding of this author's research is that the inks used in ordinary 4-color offset magazine and book printing are extremely stable in dark storage (in spite of the fact that the light fading stability of most magenta and yellow inks is very poor). Color images printed on good-quality paper will in most cases far outlast the photographic originals from which they were made. Most modern alkaline-buffered coated book papers are reasonably stable, and are fairly resistant to yellowing with age.

Stability of Color Negatives

As shown in **Tables 5.8a** (page 189) and **5.8b** (page 191), the dark fading stability of most color negative films has been substantially improved in the last 10 years. (In general, light fading is not a relevant factor with color negatives; light exposure in the enlarger is insignificant, even when making many prints from a negative.) As a group, the Kodak and Konica 400-speed and faster films, together with Kodak Vericolor III film and Fujicolor Super HG, HG 400, and Super G films rated the best in these tests.

Numerous considerations go into making a choice about which film is best for a particular job, and a photographer may decide to select a less stable film to gain some other advantage. Fujicolor Reala, which has excellent color and tone reproduction and gives exceptionally good results with difficult-to-photograph fluorescent illumination, is a case in point. Although photographers may choose a somewhat less stable color negative film such as Reala, the very worst products, such as Kodak Vericolor II Professional Film Type L, Vericolor Internegative Film 6011, and Agfacolor XRS 1000 Professional Film, should be strictly avoided.

Because color negatives are not viewed directly, but rather are used to make prints, analysis of color negative fading (and the ramifications of d-min stain or density losses) in the future will be based on the effects they have when printed. A certain amount of negative density loss and color imbalance can be satisfactorily adjusted for during printing, but more severe negative deterioration cannot.

Historically, both still camera and motion picture color negative films have had particularly poor dark fading stability — the logic being, one might suppose, that most color negatives are printed soon after processing so that fading of the negative in later years will not matter in most cases. The introduction of Kodacolor HR Disc Film in 1982 (soon followed by Kodak Vericolor III Professional Film) signaled a major advance in the stability of color negatives: the disc film had a new cyan dye-forming coupler, which produced a cyan dye of greatly increased stability. Improved-stability cyan dyes, combined with improved yellow dyes, have now been incorporated into most Kodak color negative films, both still and motion picture. Poor-stability Kodak color negative films, which have not yet been replaced with improved products, include Vericolor II Professional Film Type L and Vericolor Internegative Film.

Stability of Color Transparencies

The comparative dark storage stability of color transparency films is given in **Table 5.9** (page 193). Kodachrome clearly is the most stable transparency film in dark storage; the film is especially outstanding in terms of its total freedom from yellowish stain, even after extended aging. In spite of Kodachrome's unequaled dark storage stability, it has the worst projector-fading stability of any slide film on the market.

Among Process E-6 films, Fujichrome and Ektachrome had generally similar overall dark storage stability in these tests. Both types of film developed relatively high levels of yellowish stain, and it is stain, not dye stability, that is the most significant image stability problem with these and other E-6 films. It is expected that in the future, "low-stain" magenta couplers related to those presently employed in Fujicolor and Fujichrome papers will be utilized in Process E-6 color transparency films. Such an improvement would greatly reduce yellowish stain formation in dark storage and would substantially increase the useful dark storage life of both Fujichrome and Ektachrome films.

It should be noted that in Arrhenius test data made available to this author by Eastman Kodak (see **Table 5.13**), the more recent "Group II" Ektachrome films, including Ektachrome 64T and 320T films, "Plus," "HC," and "X" films, have much improved yellow dye stability compared with the older "Group I" types of E-6 Ektachrome. In fact, in Kodak's Arrhenius tests, the improved Ektachrome films have somewhat better *dye stability* than Kodachrome film! However, Kodak did not supply stain data for either the new or older Ektachrome films, and it is likely that by the time the least stable dye fades 20%, the films will have developed a very high stain level.

With twice the projector-fading stability of either the new or older Ektachrome films, Fujichrome has the best projector-fading stability of any color slide film (see Chapter 6). For this reason, Fujichrome is this author's primary recommendation among color slide films.

The very poor stability of the Kodak Process E-3 Professional Ektachrome films was one of the most disheartening findings of this author's tests. These films were in wide use among professional advertising and fashion photographers throughout the 1960's and up until the films were replaced by Process E-6 Ektachrome films in 1976–1977. The E-3 films had far worse stability than their "amateur" Process E-4 Ektachrome counterparts, a fact that Kodak withheld from photographers during the period these films were being marketed. Most photographers were equally unaware of the greatly superior dark fading stability of Kodachrome film over any of the Ektachrome films available during this period.

Color Microfilm

The extraordinary dye stability and total freedom from yellowish stain of Ilford Ilfochrome Micrographic Film (formerly Cibachrome Micrographic Film) during long-term accelerated tests are shown at the end of **Table 5.9** (page 194) and in **Figures 5.12** and **5.13.** Ilfochrome is made with a polyester base that is far more stable than the cellulose triacetate base used with most other color films. This author believes that when stored under typical museum and archive conditions, Ilfochrome Micrographic Film will likely outlast the silver images of conventionally processed black-and-white microfilms.

Accelerated test data as well as examination of historical silver dye-bleach color prints strongly suggest that the dye images of Ilfochrome Micrographic Film are much more resistant to the effects of peroxides and other airborne contaminants than are the very fine-grain silver images of black-and-white microfilms.

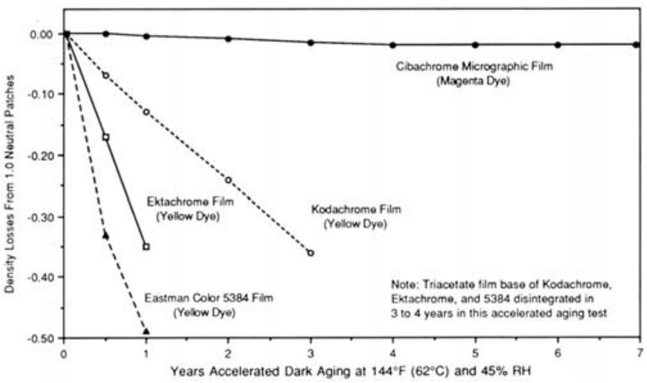


Figure 5.12 As shown in this accelerated aging test at 144°F (62°C) and 45% RH, Ilford Ilfochrome (formerly Cibachrome) Micrographic Film has extremely good dark storage stability compared with that of Kodachrome film, Ektachrome film, and Eastman 5384 color print film. Ilfochrome Micrographic Film, which is made with an extremely long-lasting polyester base, is probably more stable in typical storage conditions than conventionally processed black-and-white microfilm with silver images.

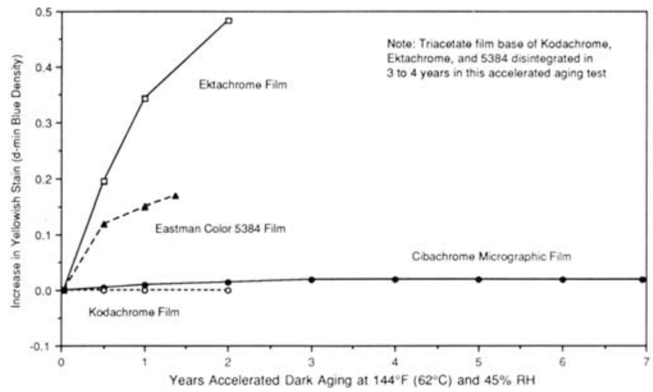


Figure 5.13 Ilford Ilfochrome (Cibachrome) Micrographic Film developed negligible yellowish stain in a test at 144°F (62°C) and 45% RH. Kodachrome film, an external-coupler chromogenic film, had no stain formation during the test, but the cellulose triacetate base of the Kodachrome disintegrated after 3 years in the test.

Manufacturers' Arrhenius Predictions for a 20% Dye Loss (Fading) in Color Materials

In August 1980, after considerable pressure from influential movie directors and professional portrait and wedding photographers, Kodak announced that the company would begin to publish stability data for its products. A compilation of these and other Kodak data[25] is given in **Table 5.13,** which begins on page 201. Unpublished Kodak data for earlier products are given in **Table 5.14** (page 204). Similar tables and data from the other manufacturers, listed in alphabetical order in **Tables 5.10** through **5.17,** which can be found on pages 195 through 209.

Kodak has also published estimates of the effect of storage temperature on dye fading rates (see **Table 5.3**), based on data from typical Kodak products, and these estimates can be used to calculate approximate storage times for temperatures other than the 75°F (24°C) used in **Tables 5.13** and **5.14**. The effect of relative humidity on the fading rates of certain humidity-sensitive yellow chromogenic dyes is given in **Table 5.4**. The estimates in **Tables 5.3** and **5.4** can also be applied in a general way to other manufacturers' color film and print materials.

With recent color negative films, Kodak has chosen to list films in "image stability categories," and to give predictions of dark storage stability in terms of a range of years that will encompass all of the films in a certain category, rather than give dark storage predictions for each type of film separately. For example, Kodak Vericolor III, Vericolor 400, Ektapress Gold 400, Kodak Gold 400, and Ektar 1000 film are all included in a category of films that Kodak predicts will last from 38 to 65 years before suffering a 20% loss of the least stable image dye when kept in dark storage at 75°F (24°C) and 40% RH. This does not mean that a specific film will last from 38 to 65 years under these conditions, but rather that the various films included in the group, which may differ in terms of their actual image stability, all will fall within this range.

Note that the predictions in **Table 5.13** and **Table 5.14** (pages 201–204) are based on storage at a relative humidity of 40%; in many places the yearly average indoor relative humidity will be higher than this, with 60% probably being more typical of the major populated areas of the world. A 60% RH could increase the overall fading rates of many products, particularly those in which the yellow dye is the least stable, by a factor of two or more. The new *ANSI IT9.9-1990* Standard recommends that dark storage tests be performed at 50% RH, and it is likely that Kodak and the other manufacturers will adopt this level in the future.

Konica employed 60% RH for the 20% dye loss predictions for its products in **Table 5.15** (page 205). With Konica color negatives in particular, in which the humidity-sensitive yellow dye is the least stable of the three image dyes, the higher humidity level may have reduced the predicted number of years for a 20% dye loss by as much as 50% versus what would have been predicted if Konica had adopted the 40% RH test condition used by Kodak and Agfa.

It should also be noted that since the introduction of Konica Color PC Paper Type SR in 1984, Konica has used a 30% dye loss criterion for evaluating its color print materials. The Konica claim of a "100-year" life for the prints in dark storage was based on Arrhenius predictions that a 30% loss of the least stable dye would not occur until more than 100 years had passed, when the prints were kept in the dark under normal room temperature conditions.

Konica has given the following predictions for years of storage required for a 30% loss of the least stable dye (cyan) for its color papers processed with a *water wash* (data for yellowish stain formation was not disclosed):

Konica Color QA Paper Type A5 . . . . 230–270 years
Konica Color QA Paper Type A3 . . . . 230–270 years
Konica Chrome Paper Type 81 . . . . 230–270 years
Konica Color QA Paper Type A2 . . . . 130 years
Konica Color QA Paper Type A . . . . 130 years
Konica Color PC Paper Type SR . . . . 130 years
Konica Color PC Paper Type EX . . . . 130 years

Table 5.3 Effect of Temperature on Dye Fading Rates at 40% Relative Humidity*

Storage Temperature	Relative Storage Time
86°F (30°C)	½X
75°F (24°C)	1X
66°F (19°C)	2X
55°F (13°C)	4X
45°F (7°C)	10X
40°F (4°C)	16X
32°F (0°C)	28X
14°F (–10°C)	100X
0°F (–18°C)	340X
–15°F (–26°C)	1000X

* Derived from: Charleton C. Bard et al., "Predicting Long-Term Storage Dye Stability Characteristics of Color Photographic Products from Short-Term Tests," **Journal of Applied Photographic Engineering**, Vol. 6, No. 2, April 1980, p. 44 (with permission). Fading rates of many dyes can be significantly greater when stored where relative humidities are higher than 40%.

Table 5.4 Effect of Relative Humidity on Fading Rates of Certain Kodak Chromogenic Yellow Dyes*

Relative Humidity	Relative Dye Fading Rate at a Specified Temperature
60%	2X
40%	1X
15%	½X

* Derived from: Charleton C. Bard et al., "Predicting Long-Term Storage Dye Stability Characteristics of Color Photographic Products from Short-Term Tests," **Journal of Applied Photographic Engineering**, Vol. 6, No. 2, April 1980, p. 43 (with permission).

Fuji, following one of the test specifications in the earlier *ANSI PH1.42-1969* color stability test Standard, gave 20% dye loss predictions for both 70% RH and <10% RH in **Table 5.11** (pages 197–198). As can be seen, the overall dye stability of Fujicolor and Fujichrome papers is little influenced by the level of relative humidity, while the yellow dyes (the least stable dyes) in Fujicolor negative and Fujichrome transparency materials fade significantly faster at the higher, 70% RH level than they do at <10% RH.

The Arrhenius tests employed by Kodak and the other manufacturers were performed according to the general procedures described by Charleton C. Bard, George W. Larson, Howell Hammond, and Clarence Packard in a 1980 article, "Predicting Long-Term Dark Storage Dye Stability Characteristics of Color Photographic Products from Short-Term Tests."[26] With some modification, this test has been adopted in the recent *ANSI IT9.9-1990* Standard for color stability test methods.

When reviewing the Kodak estimates and the data supplied by the other manufacturers in **Tables 5.10** through **5.17** (pages 195–209), keep in mind that dark storage predictions have a significant margin for error. Reporting on a 1986 presentation by Charleton Bard of the Eastman Kodak Company,[27] Klaus B. Hendriks wrote:

> Bard noted that the accuracy of the Arrhenius test is quite good. . . . However, the precision of the Arrhenius test for predicting 0.3 density loss (from an initial 1.0 density) is less reliable. To improve this situation would require a very large number of tests to be conducted for five or more years, using samples with different coatings produced under varying conditions of exposure and processing, and taking into account variations in densitometry and data analysis. According to Bard, claims that a given product will not lose 30 percent of any dye in 100 years at 24°C [75°F] and 40 percent RH may mean that such dye loss could occur as early as within 50 years or as late as in 200 years for an individual measurement. Furthermore, for a 30 percent loss of a dye there is the possibility that a decrease in density no longer accurately reflects the chemical degradation of the dye. The formation of colored decomposition products of the degraded dye may destroy the linear relationship between density and fate of the dye.[28]

Agfa has indicated that, based on its experience with the Arrhenius test, the dark storage predictions given for its products in **Table 5.10** (pages 195–196) may have a margin for error as high as 50%.

Indeed, several of the manufacturers made available to this author, data from Arrhenius tests they conducted with competitors' products (in sharing these data with this author, it was requested that they not be published). In examining these data, it was apparent that in many cases significantly different image-life predictions were obtained with a given product, depending on who conducted the Arrhenius test. Also, keep in mind that with the exception of Fuji with its low-stain Fujicolor and Fujichrome papers, none of the manufacturers supplied stain predictions for their papers and that with Kodak, Agfa, and most Konica print materials, yellowish stain in dark storage is a more serious problem than is dye fading. This, combined with the different humidity levels employed in the tests by different manufacturers, may make it difficult to make a precise comparison of the various manufacturers' products.

In spite of these uncertainties, however, the 20% dye loss predictions given in **Tables 5.10** through **5.17** are still very useful in comparing one product with another. These dye loss (fading) predictions also provide information that is vital if one is to determine what storage temperature is required for a given type of color film or print material to be preserved for extended periods (e.g., for 500 or 1,000 years). It is expected that in the future, when the major manufacturers and independent laboratories begin publishing Arrhenius fading and yellowish stain data in the manner specified in *ANSI IT9.9-1990*, and the tests are conducted at the 50% RH level recommended in the Standard, more meaningful comparisons of the dark storage stability of various products will be possible.

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Table 5.5a Comparative Dark Fading and Yellowish Staining of Current Process RA-4 Compatible Papers for Printing Color Negatives

Number of Days Required for a 20% Loss of the Least Stable Image Dye in Accelerated Dark Fading Tests at 144°F (62°C) and 45% RH

All of the papers listed were available at the time this book went to press in 1992. Initial neutral density of 1.0 with 1/2 d-min corrected densitometry.

Type of Color Paper	Days for 20% Loss of Least Stable Image Dye	Days to Reach d-min Color Imbalance of 0.10	Yellowish Stain (Blue Density) Increase After 180 Days
Fujicolor Paper Super FA Type 3 **Fujicolor Supreme Paper SFA3** **Fujicolor SFA3 Professional Portrait Paper** **Fujicolor Professional Paper SFA3 Type C** **Fujiflex SFA3 Super-Gloss Printing Material** [polyester] **Fujicolor Peel-Apart Paper SFA3** **Fujicolor Thin Paper SFA3** ("Fujicolor Print") [processed with Fuji CP-40FA (RA-4) chemicals and water wash, or with Fuji CP-40FA Stabilizer in washless minilab] (1993— for SFA3 Professional Portrait Paper) (1992— for other papers)	**380 (–C)**	**545 (C+Y)**	**+0.05Y**
Konica Color QA Paper Type A5 (Konica Color "Century Paper") (Konica Color "Century Print") (Konica Color "Long Life 100 Print") [processed with Konica CPK-20QA (RA-4) chemicals and water wash] (1990—) (initially available only in Japan)	**360 (–C)**	**615 (C+Y)**	**+0.07Y**
Konica Color QA Paper Type A3 **Konica Color QA Prof. Paper Type X2** **Konica Color QA Super Glossy Print Material Type A3** [polyester] **Konica Color QA Paper Peelable Type A3** (Konica Color "Century Paper" or "Century Print") (Konica Color "Long Life 100 Print") [processed with Konica CPK-20QA (RA-4) chemicals and water wash] (1991—)	**360 (–C)** [estimated]	**75 (C+Y)** [estimated]	**+0.28Y** [estimated]
Mitsubishi Color Paper SA 2000 **Mitsubishi Color Paper SA 5000 Pro** (papers are believed to be identical to Konica Color QA Type A3 and X2 papers) (improved type: 1992—)	**360 (–C)** [tentative]	**75 (C+Y)** [tentative]	**+0.28Y** [tentative]
Ilford Ilfocolor Deluxe Print Material (RA.1K high-gloss polyester-base print material manufactured by Ilford in Switzerland using emulsion components supplied by Konica; the stability of the Ilford product is believed to be similar if not identical to Konica Color QA Super Glossy Print Material Type A3.) (1992—)	**360 (–C)** [tentative]	**75 (C+Y)** [tentative]	**+0.28Y** [tentative]
Agfacolor Paper Type 9 **Agfacolor Paper Type 9i** [improved] ("Agfacolor Print") [Agfa AP-94 (RA-4) chemicals and water wash] (1988— for Type 9; 1992— for Type 9i)	**305 (–C)**	**90 (C+Y)**	**+0.21Y**
Kodak Ektacolor Portra II Paper ("Ektacolor Print") (1992—)	**295 (–C)**	**80 (C+Y)**	**+0.28Y**
Konica Color QA Paper Type A5 (Konica Color "Century Paper" or "Century Print") (Konica Color "Long Life 100 Print") [processed with Konica CPK-20QA (RA-4) chemicals and Konica Super Stabilizer in Konica washless minilab] (1990—) (initially available only in Japan)	**275 (–Y)**	**960 (C+Y)**	**+0.06Y**
Kodak Ektacolor Edge Paper **Kodak Ektacolor Royal II Paper** **Kodak Ektacolor Supra Paper** **Kodak Ektacolor Ultra Paper** **Kodak Duraflex RA Print Material** [polyester] ("Ektacolor Print" and "Kodalux Print") (1991— for Ektacolor Edge and Royal II) (1989— for other papers)	**190 (–C)**	**80 (C+Y)**	**+0.26Y**
Fujicolor Prof. Paper Super FA Type P (1991–93) (low-contrast professional portrait paper)	**155 (–C)**	**315 (C+Y)**	**+0.07Y**

Table 5.5b Comparative Dark Fading and Yellowish Staining of Current Process EP-2 Compatible Papers for Printing Color Negatives

Number of Days Required for a 20% Loss of the Least Stable Image Dye in Accelerated Dark Fading Tests at 144°F (62°C) and 45% RH

All of these papers were available at the time this book went to press in 1992. It is likely that many of these papers will have been discontinued by the end of 1994 in favor of faster-processing RA-4 compatible papers.

Initial neutral density of 1.0 with 1/2 d-min corrected densitometry.

Type of Color Paper	Days for 20% Loss of Least Stable Image Dye	Days to Reach d-min Color Imbalance of 0.10	Yellowish Stain (Blue Density) Increase After 180 Days
Agfacolor Paper Type 8 [improved] **Agfacolor Paper Type 8 ML** (for minilabs) ("Agfacolor Print") [EP-2 process with water wash] (1986—)	360 (–Y)	90 (C+Y)	+0.23Y
Konica Color PC Paper Type SR **Konica Color PC Paper Prof. Type EX** **Konica Color PC Paper Type SR (SG)** [polyester] **Konica Color PC Paper Peelable Type SR** (Konica Color "Century Paper") (Konica Color "Century Print") (Konica Color "Century ProPrint Type EX") (Konica Color "Long Life 100 Print") (Konica Color "Peerless Print") (In Japan, Konica Type SR paper was originally called Sakuracolor PC Paper Type SR) [processed with "improved" Konica Super Stabilizer in Konica washless minilab] (1984 [April]—for Type SR) (1984 [July]—for Type SG) (1987—for Type EX) (1988—for Peelable Type SR)	315 (–C)	160 (C+Y)	+0.11Y
Ilford Colorluxe Print Material [polyester base] (IL.1K high-gloss polyester-base print material manufactured by Ilford in Switzerland using emulsion components supplied by Konica; the stability of the Ilford product is believed to be similar if not identical to Konica Type SR [SG] polyester-base print material) [EP-2 process with water wash] (1990—)	300 (–C) [tentative]	75 (C+Y) [tentative]	+0.28Y [tentative]
Konica Color PC Paper Type SR **Konica Color PC Paper Prof. Type EX** **Konica Color PC Paper Type SR (SG)** [polyester] **Konica Color PC Paper Peelable Type SR** (Konica Color "Century Paper") (Konica Color "Century Print") (Konica Color "Century ProPrint Type EX") (Konica Color "Long Life 100 Print") (Konica Color "Peerless Print") (In Japan, Konica Type SR paper was originally called Sakuracolor PC Paper Type SR) [EP-2 process with water wash] (1984 [April]—for Type SR) (1984 [July]—for Type SG) (1987—for Type EX) (1988—for Peelable Type SR)	300 (–C)	75 (C+Y)	+0.28Y
Mitsubishi Color Paper KER Type 6000 Super **Mitsubishi Color Paper KER Type 8000 Pro** (papers manufactured by Konica and are believed to be identical to Konica Type SR and EX papers) [EP-2 process with water wash] (1985—for Type 6000 Super) (1989—for Type 8000 Pro)	300 (–C)	75 (C+Y)	+0.28Y
Kodak Ektacolor Plus Paper **Kodak Ektacolor Plus Thin Paper** **Kodak Ektacolor Professional Paper** **Kodak Duraflex Print Material** [polyester] ("Ektacolor Print") ("Kodalux Print") (formerly "Kodacolor Print") [EP-2 process with water wash] (1984 [August]—for Ektacolor Plus) (1985—for Ektacolor Professional)	230 (–C)	75 (C+Y)	+0.25Y

Table 5.5b (continued from previous page)

Type of Color Paper	Days for 20% Loss of Least Stable Image Dye	Days to Reach d-min Color Imbalance of 0.10	Yellowish Stain (Blue Density) Increase After 180 Days
Fujicolor "Minilab Paper" (Fujicolor Paper Type 03) ("Fujicolor Print") [processed with Fuji Stabilizer in Fuji washless minilab] (1988—)	**170 (–C)**	**150 (C+Y)**	**+0.13Y**
Fujicolor Paper Type 03 **Fujicolor "Minilab Paper"** **Fujicolor Prof. Paper Type 02-P** **Fujicolor Paper Type 02-C** **Fujicolor HR Printing Material** [polyester] ("Fujicolor Print") [EP-2 process with water wash] (1988—)	**155 (–C)**	**110 (C+Y)**	**+0.20Y**
Fujicolor Paper Type 12 **Fujicolor "Minilab Paper"** ("Fujicolor Print") [EP-2 process with water wash] (Type 12 paper is generally not available outside of Japan) (1985—)	**130 (–C)**	**200 (C+Y)**	**+0.11Y**
Not Recommended:			
Kodak Ektacolor Plus Paper with KIS Ultra X Press processing chemicals ("Ektacolor Print") [processed in KIS Magnum Pro Minilab with KIS Ultra X Press chemicals] (Ektacolor Plus paper processed in this manner has reduced light and dark fading stability compared with Ektacolor Plus processed with the standard EP-2 process.)	**105 (–C)**	**Data Not Available**	**Data Not Available**
Agfacolor Paper Type 8 with Agfa AP-95 processing chemicals ("Agfacolor Print") [processed with Agfa AP-95 "rapid" process with AP-95SB Stabilizer in Agfa washless minilab] (Agfacolor Paper Type 8 processed in this manner has reduced light and dark fading stability compared with Type 8 paper processed with the standard EP-2 process and water wash.)	**105 (–Y)**	**50 (C+Y)**	**+0.21Y**

Table 5.5c Comparative Dark Fading and Yellowish Staining of Discontinued Process EP-2, EP-3, and RA-4 Compatible Papers for Printing Color Negatives

Number of Days Required for a 20% Loss of the Least Stable Image Dye in Accelerated Dark Fading Tests at 144°F (62°C) and 45% RH

By the time this book went to press in 1992, these papers had been either discontinued or replaced with newer materials.
Initial neutral density of 1.0 with 1/2 d-min corrected densitometry.

Type of Color Paper	Days for 20% Loss of Least Stable Image Dye	Days to Reach d-min Color Imbalance of 0.10	Yellowish Stain (Blue Density) Increase After 180 Days
Konica Color QA Paper Type A2 Konica Color QA Paper Prof. Type X1 Konica Color QA Super Glossy Print Material Type A2 [polyester] Konica Color QA Paper Peelable Type A2 (Konica Color "Century Paper" or "Century Print") (Konica Color "Long Life 100 Print") [processed with Konica CPK-20QA (RA-4) chemicals with Konica Super Stabilizer in Konica washless minilab] (1988–92 for Type A2) (RA-4) (1990–92 for other papers)	360 (–C)	82 (C+Y)	+0.20Y
Mitsubishi Color Paper SA 2000 Mitsubishi Color Paper SA 5000 Pro (Mitsubishi "Speed Access" Paper) (Mitsubishi "Rapid Access" Paper) [processed with Mitsubishi Speed Access chemicals in washless minilab] (papers are believed to be identical to Konica Color QA Type A2 and X1 papers) (initial type: 1989–92 for SA 2000) (RA-4) (initial type: 1990–92 for SA 5000)	360 (–C) [tentative]	82 (C+Y) [tentative]	+0.20Y [tentative]
Konica Color QA Paper Type A (Konica Color "Century Paper") (Konica Color "Century Print") (Konica Color "Long Life 100 Print") (initial type: 1988–89) (RA-4)	360 (–C)	82 (C+Y)	+0.20Y
Mitsubishi Color Paper KER Type 1000 SA (Mitsubishi "Speed Access" Paper) (Mitsubishi "Rapid Access" Paper) (paper is believed to be identical to Konica Color QA Paper Type A) (1988–89) (RA-4)	360 (–C) [tentative]	82 (C+Y) [tentative]	+0.20Y [tentative]
Ilford Colorluxe Print Material [polyester] (SP-729s high-gloss polyester-base print material manufactured by Ilford in Switzerland using emulsion components supplied by Konica; the stability of the Ilford product is believed to be similar if not identical to Konica Color QA Super Glossy Print Material Type A2.) (1990–91) (RA-4)	360 (–C) [tentative]	82 (C+Y) [tentative]	+0.20Y [tentative]
Mitsubishi Color Paper KER Type 7000 Pro (paper is believed to be identical to Konica Type EX paper) (1985–89) (EP-2)	300 (–C)	75 (C+Y)	+0.28Y
Fujicolor Paper FA ("Fujicolor Print") [processed with Fuji CP-40FA (RA-4) chemicals and CP-40FA Stabilizer] (1988–89) (RA-4)	200 (–C)	130 (C+Y)	+0.16Y
Kodak Ektacolor 2001 Paper Kodak Ektacolor Portra Paper Kodak Ektacolor Royal Paper ("Ektacolor Print") ("Kodalux Print") (formerly "Kodacolor Print") [Ektacolor 2001 paper processed with Kodak RA-4 chemicals and RA-4NP Stabilizer] (1986–91 for Ektacolor 2001) (RA-4) (1989–91 for Ektacolor Royal) (1989–92 for Ektacolor Portra)	200 (–C)	75 (C+Y)	+0.25Y
Agfacolor Paper Type 8 ("Agfacolor Print") [EP-2 process with water wash] (initial type: 1984 [October]–86) (EP-2)	200 (–Y)	65 (C+Y)	+0.27Y

Table 5.5c (continued from previous page)

Type of Color Paper	Days for 20% Loss of Least Stable Image Dye	Days to Reach d-min Color Imbalance of 0.10	Yellowish Stain (Blue Density) Increase After 180 Days
Fujicolor Paper Super FA Type II Fujicolor Supreme Paper Fujicolor Professional Paper Super FA Type C Fujiflex SFA Super-Gloss Printing Material [polyester] (“Fujicolor Print”) [processed with Fuji CP-40FA (RA-4) chemicals and CP-40FA Stabilizer in Fuji washless minilab] (1990–92 for Super FA Type II and Supreme) (RA-4) (1991–92 for Super FA Type C, and Fujiflex SFA)	190 (–C)	315 (C+Y)	+0.07Y
Fujicolor Paper Super FA (“Fujicolor Print”) [processed with Fuji CP-40FA (RA-4) chemicals and CP-40FA Stabilizer in Fuji washless minilab] (initial type: 1989–90) (RA-4)	190 (–C)	315 (C+Y)	+0.07Y
Fujicolor Paper Type 02 Fujicolor Professional Paper Type 01-P Fujicolor HR Printing Material [polyester] (“Fujicolor Print”) [EP-2 process with water wash] (1985–88) (EP-2)	155 (–C)	110 (C+Y)	+0.20Y
Agfacolor Paper Type 8 [improved] (“Agfacolor Print”) [Processed with “old type” Agfa AP-92SB Stabilizer; the “improved” AP-92SB Stabilizer introduced in 1988 avoids the reduction in yellow dye stability that resulted from the original AP-92SB Stabilizer. The dark fading stability of Type 8 paper is now probably similar to that of Agfacolor Type 9 paper listed in Table 5.1a.] (1986–89) (EP-2)	120 (–Y)	120 (C+Y)	+0.19Y
Fujicolor Paper Type 8901 (“Fujicolor Print”) (1984–86) (EP-2)	80 (–C)	95 (C+Y)	+0.31Y
Kodak Ektacolor 74 RC Paper Type 2524 Kodak Ektacolor 78 Paper Type 2524 (“Kodacolor Print”) (“Ektacolor Print”) [EP-3 Process with EP-3 Stabilizer] (1982–86) (EP-2 or EP-3)	60 (–C)	115 (C+Y)	+0.19Y
Fujicolor Paper Type 8908 (1980–84) (EP-2)	55 (–C)	60 (C+Y)	+0.30Y
Kodak Ektacolor 74 RC Paper (“Kodacolor Print”) (“Ektacolor Print”) [EP-3 Process with EP-3 Stabilizer] (initial type: 1977–82) (EP-2 or EP-3)	52 (–C)	110 (C+Y)	+0.18Y
Kodak Ektacolor 37 RC Paper Type 2261 (“Kodacolor Print”) (“Ektacolor Print”) [EP-3 Process with EP-3 Stabilizer] (1971–78) (EP-3)	52 (–C)	90 (C+Y)	+0.19Y
Konica Color (Sakuracolor) PC Paper SIII (1983–84) (EP-2)	50 (–C)	66 (C+Y)	+0.33Y
Sakuracolor PC Paper SII (1978–83) (EP-2)	50 (–C)	66 (C+Y)	+0.30Y
Agfacolor PE Paper Type 7i (“Agfacolor Print”) (1984–85) (EP-2)	50 (–C)	30 (C+Y)	+0.24Y
Agfacolor PE Paper Type 589i Agfacolor PE Paper Type 7 (“Agfacolor Print”) (1983–85) (EP-2)	45 (–C)	52 (C+Y)	+0.30Y
Agfacolor PE Paper Type 589 (“Agfacolor Print”) (1981–83) (EP-2)	45 (–C)	75 (C+Y)	+0.26Y
Kodak Ektacolor 74 Paper Type 2524 Kodak Ektacolor 78 RC Paper Type 2524 (“Kodacolor Print”) (“Ektacolor Print”) [EP-2 process with water wash] (1982–86) (EP-2 or EP-3)	36 (–C)	98 (C+Y)	+0.28Y
Agfacolor PE Paper Type 5 (“Agfacolor Print”) (1977–82) (Agfa AP-87)	30 (–C)	37 (C+Y)	+0.16Y
3M Professional Color Paper Type 25 3M High Speed Color Paper 19 (1978–88; 3M ceased manufacture of color paper in 1988) (EP-2)	27 (–C)	22 (C+Y)	+0.34Y
Agfacolor PE Paper Type 4 (“Agfacolor Print”) (this paper has extremely poor dark fading stability) (1974–82) (Agfa AP-85)	6 (–C)	125 (C+Y)	+0.13Y

Table 5.6 Comparative Dark Fading and Yellowish Staining of Silver Dye-Bleach; Chromogenic Reversal; Dye-Imbibition; and UltraStable, EverColor, and Polaroid Permanent Color Pigment Print Materials

Number of Days Required for a 20% Loss of the Least Stable Image Dye or Pigment in Accelerated Dark Fading Tests at 144°F (62°C) and 45% RH

Test duration of up to 9 Years (3,285 Days)

Boldface Type indicates products that were being marketed in the U.S. and/or other countries when this book went to press in 1992; the other products listed had been either discontinued or replaced with newer materials. Initial neutral density of 1.0 with 1/2 d-min corrected densitometry.

(T) = For printing color transparencies
(T+N) = For printing either color transparencies or negatives

Type of Color Print Product	Days for 20% Loss of Least Stable Image Dye or Pigment	Days to Reach d-min Color Imbalance of 0.10	Yellowish Stain (Blue Density) Increase After 180 Days
UltraStable Permanent Color Prints (pigment color process) [polyester & fiber-base] (UltraStable Permanent Color Process) (T+N) (improved yellow pigment type: 1993—)	**>3,285 (—)** [tentative]	**>3,285 (—)** [tentative]	**+0.00Y**
Polaroid Permanent-Color Prints **Ataraxia Studio Collectors Color Prints** (pigment color process) [polyester] (T+N) (Polaroid Permanent-Color Process) (1989—)	**>3,285 (—)** [tentative]	**>3,285 (—)** [tentative]	**+0.00Y**
Fuji-Inax Photocera Color Photographs (fired pigment color process) [ceramic] (T+N) (initially available only from Fujicolor Processing Service in Japan) (1991—) (Fuji-Inax Ceramic Color Process)	**>3,285 (—)** [tentative]	**>3,285 (—)** [tentative]	**+0.00Y**
Ilford Ilfochrome Classic Prints (T) **Ilford Ilfochrome Rapid Prints** **Fuji CB Prints** (material supplied by Ilford) Ilford Cibachrome II Prints Ilford Cibachrome-A II Prints [initial type] Ilford Cibachrome-A II Prints [improved type] Ilford Cibacopy Materials (P-3, P-3X, P-30, P-30P, P-22, and P-4) [polyester and RC] (Although Ilfochrome "Pearl" semi-gloss and glossy-surface RC prints have dye stability that is similar to Ilfochrome high-gloss polyester-base prints, the RC prints are subject to RC base cracking and light-induced image yellowing, and therefore are not recommended for long-term applications.) (1980–91 for Cibachrome II) (1981–89 for "initial type" Cibachrome-A II) (1989–91 for "improved type" Cibachrome-A II) (1991— for Ilfochrome Classic and Rapid)	**>3,285 (—)**	**>3,285 (—)**	**+0.00Y**
EverColor Pigment Prints (T+N) (pigment color process) [polyester] (EverColor Pigment Color Print Process) (A high-stability version of the AgfaProof Process marketed by the EverColor Corp.) (1993—)	(new product – test data not available)		
Kodak Dye Transfer Prints (T+N) (Kodak Film and Paper Dyes and fiber-base Kodak Dye Transfer Paper) (1946—, with minor modifications)	**>3,285 (—)**	**>3,285 (—)**	**+0.02Y**
Fuji Dyecolor Prints [fiber-base] (T+N) (dye transfer type process) (available only in Japan) (1970—) (Fuji Dyecolor process)	**>3,285 (—)**	**>3,285 (—)**	**+0.02Y**
Agfachrome-Speed Color Prints (T) (single-sheet dye-diffusion process) (1983–85) (Agfachrome-Speed Process)	>3,285 (–M)	>3,285 (—)	+0.00Y
Kodak Dye Transfer Prints (T+N) (discontinued MX-1119 yellow dye available in the early 1980's) [fiber-base]	>3,285 (—)	1,300 (C+Y)	+0.05Y
Kodak Dye Transfer Prints (T+N) [fiber-base] (high-stability Kodak MX-1372 yellow dye and No. 45203 Dye Transfer receiver paper with UV-absorbing overcoat trade-tested in 1988–89) (The paper and yellow dye proved difficult to work with and Kodak decided not to market the materials.)	>3,285 (—)	150 (C+Y)	+0.13Y
Ilford Cibachrome-A Prints (T) [pigmented triacetate base] (1975–81) (P-12)	>1,460 (—)	>1,460 (—)	+0.04Y

Table 5.6 (continued from previous page)

(T) = For printing color transparencies
(T+N) = For printing either color transparencies or negatives

Type of Color Print Product	Days for 20% Loss of Least Stable Image Dye or Pigment	Days to Reach d-min Color Imbalance of 0.10	Yellowish Stain (Blue Density) Increase After 180 Days
Agfachrome CU 410 Color Prints (T) [pigmented triacetate base] (Outstanding example of the silver dye-bleach process that was abandoned by Agfa.) (1970–73) (Agfachrome Process 60)	>1,460 (—)	>1,460 (—)	Data Not Available
Kodak Ektaflex PCT Color Prints (T+N) (dye-diffusion transfer process) (Kodak Ektaflex Process) (1981–88)	1,050 (–M)	300 (+M)	+0.07Y
Fujichrome Paper Type 35 (T) **Fujichrome Copy Paper Type 35H** **Fujichrome Super-Gloss Printing Material** [glossy polyester base] ("Fujichrome Super Deluxe Prints") [polyester] (1992—) (R-3)	**370 (–C)**	**270 (C+Y)**	**+0.08Y**
Fujichrome Paper Type 34 (T) Fujichrome Copy Paper Type 34H Fujichrome Super-Gloss Printing Material [glossy polyester base] ("Fujichrome Super Deluxe Prints") [polyester] (1986–92) (R-3)	370 (–C)	270 (C+Y)	+0.08Y
Konica Chrome Paper Type 81 (T) (1989—) (R-3)	(test data not available, but probably has light fading stability similar to that of Konica Color QA Paper Type A3)		
Kodak Ektachrome Radiance Paper (T) **Kodak Ektachrome Radiance Select Material** [glossy polyester base] **Kodak Ektachrome Radiance HC Copy Paper** **Kodak Ektachrome Radiance Thin Copy Paper** (1991— for Radiance and Radiance Select) (1992— for Radiance HC and Thin Copy) (R-3)	**180 (–C)**	**140 (C+Y)**	**+0.16Y**
Kodak Ektachrome 22 Paper [improved] (T) (improved type: 1990–91) (R-3)	170 (–C)	110 (C+Y)	+0.20Y
Fujichrome Paper Type 33 (T) (1983–86) (R-3)	85 (–C)	90 (C+Y)	+0.20Y
Fujichrome Reversal Paper Type 31 (T) (1978–83) (R-100)	85 (–C)	75 (C+Y)	+0.28Y
Agfachrome Paper CRN [Type 63] (T) **Agfachrome High Gloss Material CRP** [glossy polyester base] **Agfachrome Copy Paper CRH** (1984–90 for initial types) (1990— for "improved" types) (R-3)	**63 (–C)**	**Data Not Available**	**Data Not Available**
Kodak Ektachrome RC Paper Type 1993 (T) (1972–79) (R-5)	60 (–C)	39 (C+Y)	+0.20Y
Kodak Ektachrome 14 Paper (T) (1981–85) (R-100)	53 (–C)	Data Not Available	Data Not Available
Kodak Ektachrome 2203 Paper (T) (1978–84) (R-100)	42 (–C)	120 (C+Y)	+0.12Y
Agfachrome Reversal Paper CU 310 (T) (1979–84) (R-100)	35 (–C)	Data Not Available	Data Not Available
Kodak Ektachrome Copy Paper (T) Kodak Ektachrome HC Copy Paper Kodak Ektachrome Thin Paper Kodak Ektachrome 22 Paper [initial type] Kodak Ektachrome Prestige Paper [polyester] (Not recommended: these Ektachrome papers have very poor dark fading stability compared with Fujichrome, Konica Chrome, and Agfachrome Process R-3 compatible reversal papers.) (1984–90 for initial type of Ektachrome 22) (1986–1991 for Ektachrome Prestige) (1984–92 for Ektachrome HC Copy and Thin) (1984— for Ektachrome Copy) (R-3)	**28 (–C)**	**72 (C+Y)**	**+0.26Y**

Table 5.7 Comparative Dark Fading and Yellowish Staining of Polaroid, Fuji, and Kodak Instant Color Prints; Canon and Kodak Digital Copier/Printer Color Prints; Color Offset Printing; Mead Cycolor Prints; and Thermal Dye Transfer and Ink Jet Color Prints for Digitized Pictorial Images and Computer-Generated Images

Number of Days Required for a 20% Loss of the Least Stable Image Dye in Accelerated Dark Fading Tests at 144°F (62°C) and 45% RH

Test duration of up to 6 years (2,190 days).

Boldface Type indicates products that were being marketed in the U.S. and/or other countries when this book went to press in 1992; the other products listed had been either discontinued or replaced with newer materials. After losing a patent infringement suit initiated by Polaroid, Kodak was forced to abandon the instant photography field in 1986. Initial neutral density of 1.0 with 1/2 d-min corrected densitometry.

Type of Color Print Product	Days for 20% Loss of Least Stable Image Dye	Days to Reach d-min Color Imbalance of 0.10	Yellowish Stain (Blue Density) Increase After 180 Days
3M Electrocolor Prints (T+N) [continuous-tone, liquid-toner electrophotographic color process] (Abandoned by 3M, this was an outstanding example of the liquid-toner color electrophotographic process.) (1965–66) (3M Company, St. Paul, Minnesota)	>2,190 (—)	>2,190 (—)	+0.03Y
4-Color Offset Printed Images [screened, photomechanical prints] (Cyan, magenta, yellow, and black 4-color process inks typical of those used in color offset printing of books and magazines; samples printed in 1990.)	**>2,190 (—)** [estimated]	**>2,190 (C+Y)** [estimated]	**+0.02Y**
Polaroid Polacolor ER Prints (Types 59; 559; 669; and 809) [continuous-tone instant photographic prints] (1980—) (peel-apart prints)	**>2,190 (—)**	**57 (C+Y)***	**+0.15Y***
Polaroid Polacolor 64T Prints **Polaroid Polacolor 100 Prints** **Polaroid Polacolor Pro 100 Prints** [continuous-tone instant photographic prints] (1992/93—) (peel-apart prints)	**>2,190 (—)** [estimated]	**57 (C+Y)*** [estimated]	**+0.15Y*** [estimated]
Polacolor 2 Prints (Types 88; 108; 668; 58; and 808) [continuous-tone instant photographic prints] (The images of Polacolor 2 prints suffer a yellowish color shift that may become objectionable after only a few years of dark storage under normal conditions; because of this, Polacolor 2 prints are not recommended for fine art or other critical applications.) (1975—) (peel-apart prints)	**>2,190 (—)**	**30 (M+Y)***	**+0.20Y***
Kodak Trimprint Instant Color Prints [continuous-tone instant photographic prints] (separated from backing) (1983–86)	>2,190 (—)	220 (C+Y)	+0.09Y
Kodak Trimprint Instant Color Prints [continuous-tone instant photographic prints] (not separated from backing) (1983–86)	>2,190 (—)	48 (C+Y)	+0.13Y
Polaroid SX-70 Prints [improved] [continuous-tone instant photographic prints] (1976–79)	>2,190 (—)	(see text for discussion)	
Polaroid SX-70 Time-Zero Prints **Polaroid Type 778 Time-Zero Prints** [continuous-tone instant photographic prints] (Because of high levels of yellowish stain that form over time in normal dark storage, Polaroid SX-70 Time-Zero and Type 778 prints are not recommended for other than short-term applications.) (improved type: 1980—)	**>2,190 (—)**	**(see text for discussion)**	
Polaroid High Speed Type 779 Prints **Polaroid Autofilm Type 339 Prints** Polaroid 600 High Speed Prints [continuous-tone instant photographic prints] (Because of high levels of yellowish stain that form over time in normal dark storage, Polaroid Type 779 and Type 339 prints are not recommended for other than short-term applications.) (1981–88 for Polaroid 600) (1981— for other prints)	**>2,190 (—)**	**(see text for discussion)**	

Table 5.7 (continued from previous page)

Type of Color Print Product	Days for 20% Loss of Least Stable Image Dye	Days to Reach d-min Color Imbalance of 0.10	Yellowish Stain (Blue Density) Increase After 180 Days
Iris Ink Jet Color Prints [scanned, electronically produced prints] (Ink jet color prints made on 100% cotton fiber paper with Iris Graphics, Inc. 3047 printer using the "Standard" Iris ink set; test prints made in 1992.)	**>1,095 (—)** [estimated]	**>1,095 (C+Y)** [estimated]	**+0.01Y**
Stork Ink Jet Color Prints [scanned, electronically produced prints] (Ink jet prints made with a Stork Bedford B.V. ink jet printer using both the "Standard" and "Reactive Dyes" ink sets; prints made in 1992.)	**>1,095 (—)** [estimated]	**>1,095 (C+Y)** [estimated]	**+0.01Y** [estimated]
Polaroid 600 Plus Prints **Polaroid Autofilm Type 330 Prints** **Polaroid Type 990 Prints** Polaroid Spectra Prints Polaroid Image Prints (Spectra name in Europe) [continuous-tone instant photographic prints] (Because of high levels of yellowish stain that form over time in normal dark storage, Polaroid Spectra prints, Image prints, 600 Plus prints, and other Polaroid products using the Spectra emulsion are not recommended for other than short-term applications.) (1986–91 for Spectra prints) (1988— for other prints)	**>1,095 (—)**	**(see text for discussion)**	
Polaroid Spectra HD Prints **Polaroid Image Prints** (Spectra in Europe) [continuous-tone instant photographic prints] (Because of high levels of yellowish stain that form over time in normal dark storage, Polaroid Spectra HD prints, Image prints and other Polaroid products using the Spectra HD emulsion are not recommended for other than short-term applications.) (1992—)	**>1,095 (—)** [tentative]	**(see text for discussion)**	
Polaroid Vision 95 Prints (in Europe) **Polaroid " ? " 95 Prints** (name in Asia) **Polaroid " ? " 95 Prints** (name in North & South America) [continuous-tone instant photographic prints] (The internal structure of Vision 95 prints is basically the same as that of Spectra HD and 600 Plus prints; however, the rate of formation of yellowish stain that occurs over time in dark storage is said by Polaroid to be "somewhat reduced" compared with that of Spectra HD and 600 Plus prints. The names Polaroid will use for Vision 95 products in non-European markets were not available at the time this book went to press.) (1992— for Vision 95 products sold in Germany) (1993— for Asia, North and South America, and other markets)	**>1,095 (—)** [tentative]	**(see text for discussion)**	
Kodak Kodamatic Instant Color Prints [continuous-tone instant photographic prints] (1982–86)	1,400 (–M)	36 (C+Y)	+0.14Y
Canon Color Laser Copier Prints [scanned, electronically produced prints] (Xerographic plain-paper digital color copier/printer; test prints made in 1989.)	**>730 (—)**	**>730 (C+Y)**	**+0.03Y**
Kodak ColorEdge Copier Prints [scanned, electronically produced prints] (Xerographic plain-paper digital color copier/printer; test prints made in 1992.)	**>730 (—)** [estimated]	**>730 (C+Y)** [estimated]	**+0.03Y** [estimated]
Polaroid Polacolor Prints [initial type] [continuous-tone instant photographic prints] (1963–75) (peel-apart prints)	>500 (—)	>500 (C+Y)	+0.03Y
Mead Cycolor Prints [continuous-tone photographic prints] (Mead Imaging Corporation microencapsulated acrylate image color prints made with a Noritsu QPS-101 Cycolor Slideprinter; test prints made in 1988.) (1988—)	**>500 (—)**	**500 (C+Y)**	**+0.06Y**
Fuji 800 Instant Color Prints [continuous-tone instant photographic prints] (1984—) (available only in Japan)	**470 (–M)**	**55 (C+Y)**	**+0.20Y**
Fuji FI-10 Instant Color Prints [continuous-tone instant photographic prints] (1981—) (available only in Japan)	**300 (–M)**	**160 (M+Y)**	**+0.19Y**
Kodak PR10 Instant Color Prints [continuous-tone instant photographic prints] (initial type: 1976–79)	250 (–M)	90 (C+Y)	+0.14Y
Kodak Ektatherm Color Prints* [scanned, electronically produced prints] (Thermal dye transfer color prints made with Kodak XL 7700 Digital Printer; test prints made in 1992.)	**65 (–C)**	**80 (C+Y)**	**+0.21Y**
Sony Mavigraph Still Video Prints* [scanned, electronically produced prints] (Thermal dye transfer prints made with Sony UP-5000 ProMavica Color Video Printer; test prints made in 1989.)	**6 (–C)**	**Data Not Available**	**Data Not Available**

*** Note:** Heat-accelerated dark fading tests may not give a meaningful indication of the long-term stability of prints of this type — see text.

Table 5.8a Comparative Dark Fading Stability of Current Color Negative Films

Number of Days Required for a 20% Loss of the Least Stable Image Dye in Accelerated Dark Fading Tests at 144°F (62°C) and 45% RH

These films, which were available in the U.S. and/or other countries when this book went to press in 1992, are all compatible with Kodak Process C-41. Dye losses measured from an initial neutral density of 1.0 above d-min with full d-min corrected densitometry.

Type of Color Negative Film	Days for 20% Loss of Least Stable Image Dye
Kodak Vericolor III Professional Film, Type S (1983—) **Kodak Ektacolor Gold 160 Professional Film** (1986—) **Kodak Ektacolor GPF 160 Professional Film** (1991—) (In the U.S., Ektacolor GPF is sold only in 8-exposure 35mm rolls)	**215 (–Y)**
Kodak Vericolor 400 Professional Film **Kodak Ektacolor Gold 400 Professional Film** (1988— **)**	**200 (–Y)**
Kodak Ektapress Gold 1600 Professional Film (1988—) **Kodak Ektar 1000 Film** (1988—) **Kodak Gold 1600 Film** (1991—)	**200 (–Y)**
Konica Color SR-G 3200 Professional Film **Konica Color GX3200 Professional Film** (1989—)	**180 (–C)**
Konica Color Super SR 400 Film **Konica Color Super DD 400 Film** **Konica Color XG400 Film** **Polaroid HighDefinition 400 Color Print Film** (Polaroid HighDefinition 400 film is made by Konica in Japan; it was introduced in Europe in 1990, and in the U.S. in 1992.) (1990—) (1992— for XG400 film, which is sold in Japan)	**180 (–C)** [tentative]
Kodak Ektapress Gold 400 Professional Film (1988—)	**175 (–Y)**
Kodak Gold Plus 400 Film (1992—) **Kodak Gold II 400 Film** (name in Europe)	**175 (–Y)**
3M ScotchColor 100 Film (Although this film is labeled by 3M as "Made in U.S.A.," it is actually manufactured in Italy by a subsidiary of the 3M Company, St. Paul, Minnesota.) (improved type: 1990—)	**145 (–Y)**
3M ScotchColor 200 Film **Polaroid OneFilm Color Print Film** (ISO 200) (Although these films are labeled by 3M and Polaroid as "Made in U.S.A.", they are actually manufactured in Italy by a subsidiary of the 3M Company, St. Paul, Minnesota.) (improved type: 1990—)	**145 (–Y)** [tentative]
3M ScotchColor 400 Film (Although this film is labeled by 3M as "Made in U.S.A.," it is actually manufactured in Italy by a subsidiary of the 3M Company.) (improved type: 1991—)	**145 (–Y)** [tentative]
Konica Color Super SR 200 Film (U.S.A. market only) **Konica Color Super SR 200 Professional Film** (1990—)	**140 (–Y)** [tentative]
Kodak Ektar 100 Film (1991—)	**130 (–Y)**
Fujicolor Super G 100 Film **Fujicolor Super G 200 Film** **Fujicolor Super G 400 Film** (1992—)	**130 (–Y)** [tentative]
Fujicolor Super HG 100 Film Fujicolor Super HG 200 Film Fujicolor Super HG 400 Film **Fujicolor Super HG 1600 Film** (1989–92 for Super HG 200 and 400) (1990–92 for Super HG 100) (1990— for Super HG 1600)	**130 (–Y)**
Fujicolor HG 400 Professional Film (1991—)	**130 (–Y)** [tentative]
Konica Color Impresa 50 Professional Film (1991—)	**110 (–Y)** [tentative]
Konica Color Super SR 100 and Super DD 100 Films **Konica Color Super SR 200 Film** **Konica Color Super DD 200 Professional Film** **Polaroid HighDefinition 100 and 200 Color Print Films** (Polaroid HighDefinition 100 and 200 films are made by Konica in Japan; they were introduced in Europe in 1990, and in the U.S. in 1992.) (1990—)	**110 (–Y)** [tentative]
Kodak Kodacolor VR 100, VR 200, and VR 400 Films (Kodacolor VR films are still manufactured by Kodak in Europe and are sold worldwide.) (1983—)	**110 (–Y)**

Table 5.8a (continued from previous page)

Type of Color Negative Film	Days for 20% Loss of Least Stable Image Dye
Agfacolor XRC and XRG 400 Films (1988—) **Agfacolor XRS 400 Professional Film** (1989—)	**100 (–Y)**
Fujicolor 160 Professional Film S **Fujicolor 160 Professional Film L** (1985—)	**90 (–Y)**
Kodak Ektar 25 Film (1988—) **Kodak Ektar 25 Professional Film** (1989—)	**90 (–Y)**
Fujicolor Reala Film (ISO 100) (1989—)	**85 (–Y)**
Kodak Ektapress Gold 100 Professional Film (1988—)	**85 (–Y)**
Kodak Gold Plus 100 Film **Kodak Gold II 100 Film** (name in Europe) (1992—)	**85 (–Y)** [tentative]
Kodak Gold Plus 200 Film **Kodak Gold II 200 Film** (name in Europe) (1992—)	**85 (–Y)** [tentative]
Kodak Vericolor HC Professional Film (1987—)	**85 (–Y)**
Agfacolor XRC and XRG 100 Films (1988—)	**75 (–Y)**
Agfacolor XRS 100 Professional Film **Agfacolor XRS 200 Professional Film** (1989—)	**75 (–Y)**
Agfacolor Ultra 50 Professional Film **Agfacolor Optima 125 Professional Film** **Agfacolor Portrait 160 Professional Film** (1990—)	**75 (–Y)** [tentative]
Agfacolor Optima 200 Professional Film (1992—)	**75 (–Y)** [tentative]
Agfacolor XRC and XRG 200 Film (improved type: 1992—)	**75 (–Y)** [tentative]
Agfacolor XRS 1000 Professional Film (1984—)	**45 (–C)**
Kodak Vericolor II Professional Film, Type L (1974—)	**30 (–C)**

Table 5.8b Comparative Dark Fading Stability of Discontinued Color Negative Films

Number of Days Required for a 20% Loss of the Least Stable Image Dye in Accelerated Dark Fading Tests at 144°F (62°C) and 45% RH

All films are compatible with Kodak Process C-41 unless otherwise noted.
Dye losses measured from an initial neutral density of 1.0 above d-min with full d-min corrected densitometry.

Type of Color Negative Film	Days for 20% Loss of Least Stable Image Dye
Kodak Kodacolor Gold 1600 Film (1989–91)	200 (–Y)
Konica Color SR-V 3200 Professional Film (1987–89)	180 (–C)
Konica Color SR-V 400 Film Konica Color GX400 Film (1987–89)	180 (–C)
Konica Color SR-G 400 Film Konica Color GX400 Film Polaroid HighDefinition 400 Colour Print Film (Polaroid HighDefinition 400 film was made by Konica in Japan and was marketed in Europe and Australia.) (1989–90)	180 (–C) [tentative]
Kodacolor Gold 400 Film ("Improved") (1991–92)	175 (–Y) [tentative]
Kodacolor Gold 400 Film ("Improved") (formerly Kodacolor VR-G 400 Film) (1987–89)	175 (–Y)
Kodacolor VR-G 400 Film Kodacolor Gold 400 Film (Kodacolor VR-G 400 was introduced in January 1986, and then almost immediately withdrawn; a new version was introduced in September 1987.) (initial type: 1986–87)	175 (–Y)
Konica Color SR-G 200 Film Konica Color GX200 Film Konica Color GX200 Professional Film Polaroid HighDefinition 200 Colour Print Film (Polaroid HighDefinition 200 film was made by Konica in Japan and was marketed in Europe and Australia.) (1989–90) Konica Color and Sakuracolor SR-V 100 Film Konica Color SR-V 200 Film Konica Color GX200 Professional Film (initial type: 1986–90)	140 (–Y)
Kodak Ektar 125 Film (1989–91)	130 (–Y)
Fujicolor Super HRII 100 Film Fujicolor Super HRII 1600 Film (1989–90)	120 (–Y)
Fujicolor Super HR 100 Film Fujicolor Super HR 200 Film Fujicolor Super HR 400 Film Fujicolor Super HR 1600 Film (1986–89)	115 (–Y)
Konica Color SR-V 100 Film (improved type: 1987–89)	115 (–C)
Konica Color SR 200 Film Sakuracolor SR 200 Film (initial type: 1983–86)	115 (–C)
Konica Color SR-G 100 Film Konica Color GXII 100 Film Polaroid HighDefinition 100 Colour Print Film (Polaroid HighDefinition 100 film was made by Konica in Japan and was marketed in Europe and Australia.) (1989–90)	110 (–Y)
Kodacolor VR 1000 Film (1984–89)	105 (–Y)
Kodak Gold 100 Film (1991–92) Kodak Kodacolor Gold 100 Film (1986–91) (formerly Kodacolor VR-G 100 Film)	85 (–Y)
Kodak Gold 200 Film (1991–92) Kodak Kodacolor Gold 200 Film (1986–91) (formerly Kodacolor VR-G 200 Film)	85 (–Y)
Agfacolor XRC and XRG 200 Films (initial type: 1989–92)	75 (–Y)

Table 5.8b (continued from previous page)

Type of Color Negative Film	Days for 20% Loss of Least Stable Image Dye
Discontinued Films with Comparatively Poor Stability (listed in alphabetical order)	
Agfacolor XRS 100 Professional Film Agfacolor XR 100 Film Agfacolor XR 200 Film Agfacolor XRS 200 Professional Film Agfacolor XRS 400 Professional Film (1983–89)	
Fujicolor HR 100 Film Fujicolor HR 200 Film Fujicolor HR 400 Film Fujicolor HR 1600 Film (1983–86)	
Fujicolor F-II Film (1974–83)	
Fujicolor F-II 400 Film (1976–83)	
Ilford Ilfocolor HR 100 Film Ilford Ilfocolor HR 200 Film Ilford Ilfocolor HR 400 Film (Ilfocolor films made by Agfa were marketed from March 1987 to May 1988.) (same as Agfacolor XR films)	**All films in this group:** 30 to 60 days (–C)
Kodacolor 400 Film (1977–84)	
Kodacolor II Film (1972–84)	
Kodacolor-X Film (1963–74) (Process C-22)	
Kodak Ektacolor Professional Film, Type S (1956–63) (Process C-22)	
Kodak Vericolor II Professional Film, Type S (1974–83)	
Kodak Vericolor Commercial Film, Type S (1979–86)	

Type of Color Negative Film	Days for 20% Loss of Least Stable Image Dye
Discontinued Films with Comparatively Poor Stability (listed in alphabetical order)	
Konica Color SR 100 Film Konica Color SR 200 Film Konica Color SR 400 Film Konica Color SR 1600 Film (same for equivalent Sakuracolor films) (1984–87)	
Konica Color SR Professional Film Type S Sakuracolor SR Professional Film Type S (1985–89)	
Polaroid Supercolor 100 Print Film (Initial type of Polaroid Supercolor film made by Agfa and sold in Spain and Portugal beginning in 1987.) (1987–89)	
3M Scotch HR 100 Film (Although this film was labeled by 3M as “Made in U.S.A.,” it was actually manufactured in Italy by a subsidiary of the 3M Company, St. Paul, Minnesota.) (initial type: 1986–90)	**All films in this group:** 30 to 60 days (–C)
3M ScotchColor 200 Film 3M Scotch HR 200 Color Print Film Polaroid OneFilm Color Print Film (ISO 200) (Although these films were labeled by 3M and Polaroid as “Made in U.S.A.,” they were actually manufactured in Italy by a subsidiary of the 3M Company, St. Paul, Minnesota.) (initial type: 1986/89–90)	
3M ScotchColor 400 Film 3M Scotch HR 400 Color Print Film (Although these films were labeled by 3M as “Made in U.S.A.,” they were actually manufactured in Italy by a subsidiary of the 3M Company, St. Paul, Minnesota.) (1986–91)	

Table 5.9 Comparative Dark Fading and Yellowish Staining of Color Transparency Films

Number of Days Required for a 20% Loss of the Least Stable Image Dye in Accelerated Dark Fading Tests at 144°F (62°C) and 45% RH

Test Duration of Up to 7 Years (2,555 Days)

Boldface Type indicates products that were being marketed in the U.S. and/or other countries when this book went to press in 1992; the other products listed had been either discontinued or replaced with newer materials. Initial neutral density of 1.0 with full d-min corrected densitometry.

Type of Color Film	Days for 20% Loss of Least Stable Image Dye	Days to Reach d-min Color Imbalance of 0.10	Yellowish Stain (Blue Density) Increase After 180 Days
Kodachrome 25, 64, and 200 professional and amateur films; Kodachrome 40 Type A Film (1974—) (K-14)	**580 (–Y)**	**>1,200 (—)**	**+0.00Y**
Kodachrome II and Kodachrome-X films Kodachrome II Professional Type A Film (1961–74) (K-12)	320 (–Y)	>1,200 (—)	+0.00Y
Kodak Ektachrome 64T and 320T, "Plus" and "X" professional films, and Ektachrome "HC" amateur films (64X and 64T; 1991—; 100X: 1990—; 400X: 1992—; 100 Plus and HC: 1988—; 50 HC: 1990—; 400 HC and 320T: 1992—)	**225 (–C)**	**60 (C+Y)**	**+0.28Y**
Kodak Ektachrome professional and amateur films, and Ektachrome duplicating films (not including the "Group II" 64T and 320T, "Plus," "HC," and "X" films listed above) (1976—) (E-6)	**210 (–C)**	**80 (C+Y)**	**+0.19Y**
Fujichrome professional and amateur films, and Fujichrome duplicating films (not including Fujichrome Velvia Prof. Film) (initial types: 1983–88/89) (E-6) (improved types: 1988/89/92—)	**185 (–C)**	**45 (C+Y)**	**+0.24Y**
Polaroid Professional Chrome Film 64T and 100D films (These 4x5-inch format films are made for Polaroid by Fuji in Japan.) (1987—) (E-6)	**185 (–C)**	**45 (C+Y)**	**+0.24Y**
Fujichrome 100 and 400 films (initial types: 1978–84) (E-6)	185 (–C)	50 (C+Y)	+0.26Y

Type of Color Film	Days for 20% Loss of Least Stable Image Dye	Days to Reach d-min Color Imbalance of 0.10	Yellowish Stain (Blue Density) Increase After 180 Days
GAF 64, 200, and 500 Color Slide films (1969–77) (GAF Process AR-1)	180 (–Y)	365 (C+Y)	+0.07Y
Agfachrome 64 and 100 films (Agfa Process AP-41) (1976–83)	180 (–Y)	>600 (C+Y)	+0.02Y
Konica Chrome R-50, R-100, R-200, and R-1000 professional films (1990—) (E-6)		**(Data Not Available)**	
Konica Chrome RD100 Color Reversal Film Polaroid HighDefinition 100 Chrome Film (Polaroid HighDefinition 100 Chrome Film is made for Polaroid by Konica in Japan and is marketed in Europe and Australia.) (1986/89—) (E-6)		**(Data Not Available)**	
Agfachrome RS 50 Plus and RS 100 Plus Professional films and Agfachrome CT 100 Plus Film (1992—) (E-6)	**140 (–Y)** [tentative]	**150 (C+Y)** [tentative]	**+0.10Y** [tentative]
Agfachrome RS 50 and RS 100 Professional films and Agfachrome CT 100 Film (improved types: 1988–92) (E-6)	140 (–Y)	150 (C+Y)	+0.10Y
Agfachrome RS 200 Professional and Agfachrome CT 200 films (improved types: 1988—) (E-6)	**140 (–Y)**	**150 (C+Y)**	**+0.10Y**
Agfachrome RS 200 Professional and Agfachrome CT 200 films (initial types: 1983–85) (E-6)	140 (–Y)	24 (C+Y)	+0.31Y
Fujichrome Velvia Professional Film (1990—) (ISO 50) (E-6)	**135 (–Y)**	**90 (C+Y)**	**+0.14Y**

Table 5.9 (continued from previous page)

Type of Color Film	Days for 20% Loss of Least Stable Image Dye	Days to Reach d-min Color Imbalance of 0.10	Yellowish Stain (Blue Density) Increase After 180 Days
Kodak Ektachrome-X Film Kodak High Speed Ektachrome Film Kodak High Speed Ektachrome Film Type B (Tungsten) (1963–77) (E-4)	120 (–C)	90 (C+Y)	+0.16Y
3M ScotchChrome 100, 400, 800/3200, and 640T films **Polaroid Presentation Chrome Film** (100) (1988—) (E-6) 3M Scotch 640T Color Slide Film (1981–89) (Polaroid Presentation Chrome Film is made for Polaroid by the 3M Company) (although these films are labeled by 3M and Polaroid as "Made in U.S.A.," they are actually manufactured in Italy by a 3M subsidiary.)	**95 (–C)**	**70 (C+Y)**	**+0.21Y**
Polaroid PolaChrome Instant Slide Film (Because of very poor stability in humid storage conditions and formation of severe, irregular stain during projection, this film is not recommended for other than short-term applications.) (1983—) (Polaroid instant process)	**90 (–C)**	**80 (C+Y)**	**+0.14Y**
Agfachrome RS 1000 Prof. Film Agfachrome RS 50 Prof. Film Agfachrome RS 100 Prof. and CT Films (1984–88) (E-6)	**75 (–Y)**	**210 (C+Y)**	**+0.07Y**
Ilford Ilfochrome 50 Color Slide Film Ilford Ilfochrome 100 Color Slide Film (Ilfochrome slide films made by Agfa were marketed in 1987–88.) (E-6) Polaroid Superchrome 100 Slide Film (Initial type of Polaroid Superchrome film made by Agfa and sold in Spain and Portugal in 1987–88.) (E-6)	75 (–Y)	210 (C+Y)	+0.07Y
Agfachrome 200 Professional Film (initial type: 1982–84) (E-6)	70 (–C)	12 (C+Y)	+0.53Y
Fujichrome R-100 Film (1968–73) (E-4)	55 (–C)	50 (C+Y)	+0.18Y
3M ScotchChrome 1000 Film (1988—) 3M Scotch 1000 Color Slide Film (1983–88) 3M Scotch 100 Color Slide Film (1984–88) 3M CRT 100 Color Slide Film (1985–88) Polaroid Presentation Chrome 35mm Film (1985–88) (E-6) (Although these films were labeled by 3M and Polaroid as "Made in U.S.A.," they were actually manufactured in Italy by a 3M subsidiary.)	**45 (–C)**	**140 (C+Y)**	**+0.09Y**
Kodak Ektachrome Professional films (sheet and 120 roll films) (1959–77) (E-3)	13 (–C)	25 (C+Y)	+0.28Y
Color Microfilm			
Ilford Ilfochrome Micrographic Film, Type M and Type P (called Ilford Cibachrome Micrographic Film, 1984–91) (1984—) (Ilfochrome Process P-5)	**>2,555 (—)**	**>2,555 (—)**	**+0.01Y**

Table 5.10 Predicted Dark Fading Stability of Agfa Color Print Materials, Color Negatives, and Transparencies (from Data Supplied by Agfa-Gevaert and Based on Arrhenius Accelerated Dark Fading Tests)

Estimated Storage Time for a 20% Loss of the Least Stable Image Dye for Storage in the Dark at 75°F (24°C)

(Note: Predictions Are for Storage at 40% RH)

Boldface Type indicates products that were being marketed in the U.S., Germany, and/or other countries when this book went to press in 1992; the other products listed had been either discontinued or replaced with newer materials. These estimates are based on initial cyan, magenta, and yellow densities of 1.0 with full d-min corrected densitometry. These estimates are for dye fading only and do not take into account the gradual formation of yellowish stain. With print materials in particular (e.g., Agfacolor Type 8 and Type 9 papers), the level of stain may become objectionable before the least stable image dye has faded 20%.

(N) = For printing color negatives
(T) = For printing color transparencies

Color Papers and Display Films:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
Agfacolor Paper Type 9 (RA-4) (N) (RA-4 compatible paper processed with Agfa AP-94 chemicals and Agfa AP-94SB Stabilizer in Agfa "washless" minilab) (1988—)	**120 (–Y)** [tentative]
Agfacolor Paper Type 9 (RA-4) (N) (RA-4 compatible paper processed with Agfa AP-94 chemicals and water wash) (1988—)	**120 (–Y)** [tentative]
Agfacolor Paper Type 9i [improved] (RA-4) (N) (RA-4 compatible paper processed with Agfa AP-94 chemicals and water wash) (1992—)	**(not disclosed)**
Agfacolor Paper Type 8 [improved] (EP-2) (N) (processed with Agfa AP-92 [EP-2] chemicals and water wash) (1986—)	**120 (–Y)**
Agfacolor Paper Type 8 [improved] (EP-2) (N) (processed with Agfa AP-92 [EP-2] chemicals and "improved" Agfa AP-92SB Stabilizer in Agfa "washless" minilab) (1986—)	**120 (–Y)***
Agfacolor Paper Type 8 [improved] (EP-2) (N) (processed in Agfa AP-95 rapid-process chemicals with "improved" Agfa AP-95SB Stabilizer in Agfa "washless" minilab)	**(not disclosed)**
Agfacolor Paper Type 8 (EP-2) (N) (initial type: 1984)	120 (–Y)
Agfatrans and Agfaclear Display Films (EP-2) (N) (1989—)	**120 (–Y)**

(N) = For printing color negatives
(T) = For printing color transparencies

Color Papers and Display Films:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
Agfachrome Paper CRN [Type 63] (R-3) (T) **Agfachrome High Gloss Material CRP** [polyester] **Agfachrome Copy Paper CRH** **Agfachrome Overhead Film CRF** (1990—)	**85 (–C)**
Agfachrome Reversal Paper Type 63 (R-3) (T) Agfachrome CR 410 High-Gloss Reversal Material [polyester] Agfachrome Reversal Copy Paper Agfachrome Overhead CRF Reversal Material (1984–90)	85 (–C)
Process C-41 Compatible Color Negative Films:	
Agfacolor Ultra 50 Professional Film **Agfacolor Optima 125 Professional Film** **Agfacolor Portrait 160 Professional Film** (1990—)	**(not disclosed)**
Agfacolor Optima 200 Professional Film (1992—)	**(not disclosed)**
Agfacolor Optima 400 Professional Film (1992—)	**(not disclosed)**
Agfacolor XRC and XRG 100 Film **Agfacolor XRC and XRG 400 Film** (1988—) Agfacolor XRC and XRG 200 Film (1989–92)	**30 (–Y)**

Table 5.10 (continued from previous page)

Process C-41 Compatible Color Negative Films:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
Agfacolor XRC and XRG 200 Film (improved type: 1992—)	**(not disclosed)**
Agfacolor XRS 100 Professional Film **Agfacolor XRS 200 Professional Film** **Agfacolor XRS 400 Professional Film** (1989—)	**30 (–Y)**
Agfacolor XR 100 Film Agfacolor XR 100i Film [improved] Agfacolor XR 200 Film Agfacolor XR 400 Film (1983–89)	15 (–C)
Agfacolor XRS 100 Professional Film Agfacolor XRS 200 Professional Film Agfacolor XRS 400 Professional Film (1984–89)	15 (–C)
Agfacolor XRS 1000 Professional Film (1984–1989)	15 (–C)
Agfacolor XRS 1000 Professional Film (improved type: 1989—)	**(not disclosed)**

* According to Agfa, "The stability of Agfacolor Type 8 Paper stabilized in fresh AP-92SB is slightly better than normally washed material. This situation can change somewhat after the solution has become seasoned. This situation is not specific to [Agfa] color paper and chemistry, but instead it is common to all color papers and stabilizers." Use of the initial version of Agfa process AP-92 stabilizer in "washless" processing resulted in a reduction in the stability of the yellow dye in Agfacolor Type 8 paper; an improved stabilizer formulation that corrected this shortcoming was introduced in 1988.

Process E-6 Compatible Color Transparency Films:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
Agfachrome RS 50 Professional Film (improved type: 1988–92)	55 (–Y)
Agfachrome RS 50 Plus Professional Film (1992—)	**(not disclosed)**
Agfachrome RS 100 Professional and CT Films (improved type: 1988–92)	55 (–Y)
Agfachrome RS 100 Plus Professional and CT Films (1992—)	**(not disclosed)**
Agfachrome RS 200 Professional and CT Films (improved type: 1988—)	**55 (–Y)**
Agfachrome RS 50 Professional Film Agfachrome RS 100 Professional and CT Films (1984–88)	32 (–Y)
Agfachrome RS 200 Professional and CT Films (initial type: 1983–85)	30 (–Y)
Agfachrome RS 200 Professional and CT Films (improved type: 1985–88)	30 (–Y)
Agfachrome RS 1000 Professional Film (1987–92)	30 (–Y)
Agfachrome RS 1000 Professional Film (improved type: 1992—)	**(not disclosed)**

Table 5.11 Predicted Dark Fading Stability of Fuji Color Print Materials, Color Negatives, and Transparencies (from Data Supplied by Fuji and Based on Arrhenius Accelerated Dark Fading Tests)

Estimated Storage Time for a 20% Loss of the Least Stable Image Dye for Storage in the Dark at 75°F (24°C)
(Note: Predictions Are for Storage at <10% RH and 70% RH)

Boldface Type indicates products that were being marketed in the U.S., Japan, and/or other countries when this book went to press in 1992; the other products listed had been either discontinued or replaced with newer materials. These estimates are based on initial cyan, magenta, and yellow densities of 1.0 with full d-min corrected densitometry. These estimates are for dye fading only and do not take into account the gradual formation of yellowish stain. With earlier types of Fuji print materials (e.g., EP-2 compatible Fujicolor papers), the level of stain may become objectionable before the least stable image dye has faded 20%.

(N) = For printing color negatives
(T) = For printing color transparencies
(T+N) = For printing either transparencies or negatives

Color Papers and Display Films:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
Fujicolor Paper Super FA Type 3 (RA-4)(N) **Fujicolor Supreme Paper SFA3** **Fujicolor SFA3 Professional Portrait Paper** **Fujicolor Professional Paper SFA3 Type C** **Fujiflex SFA3 Super-Gloss Printing Material** [polyester] **Fujicolor Peel-Apart Paper SFA3** **Fujicolor Thin Paper SFA3** (RA-4 compatible paper processed with Fuji CP-40FA chemicals and Fuji washless stabilizer or with water wash) (1993— for Prof. Portrait Paper; 1992— for other papers)	**120 (–C)** [<10% RH] **100 (–C)** [70% RH]
Fujicolor Paper Super FA Type II (RA-4) (N) Fujicolor Supreme Paper **Fujicolor Professional Paper Super FA Type P** Fujicolor Professional Paper Super FA Type C Fujiflex SFA Super-Gloss Printing Material [polyester] (RA-4 compatible paper processed with Fuji CP-40FA chemicals and Fuji washless stabilizer or with water wash) (1991–92 for Super FA Type C, and Fujiflex SFA) (1990–92 for Super FA Type II and Supreme) (1991–93 for Prof. Super FA Type P)	**80 (–C)** [<10% RH] **70 (–C)** [70% RH]
Fujicolor Paper Super FA (RA-4) (N) Fujicolor Paper FA (RA-4 compatible papers processed with Fuji CP-40FA chemicals and stabilizer in Fuji "washless" minilab) (1989–90)	80 (–C) [<10% RH] 70 (–C) [70% RH]
Fujicolor Paper Super FA (RA-4) (N) Fujicolor Paper FA (RA-4 compatible papers processed with Fuji CP-40FA chemicals and water wash) (1989–90)	80 (–C) [<10% RH] 70 (–C) [70% RH]

(N) = For printing color negatives
(T) = For printing color transparencies
(T+N) = For printing either transparencies or negatives

Color Papers and Display Films:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
Fujicolor Paper Type 03 (EP-2) (N) **Fujicolor "Minilab Paper"** **Fujicolor Professional Paper Type 02-P** **Fujicolor HR Printing Material** [polyester] Fujicolor Paper Type 02 Fujicolor Professional Paper Type 01-P	**60 (–C)** [<10% RH] **50 (–C)** [70% RH]
Fujicolor Paper Type 12 (EP-2) (N) **Fujicolor "Minilab Paper"**	**60 (–C)** [<10% RH] **50 (–C)** [70% RH]
Fujicolor Minilab Paper (EP-2) (N) (processed with Fuji Stabilizer in Fuji washless minilab)	**60 (–C)** [<10% RH] **50 (–C)** [70% RH]
Fujitrans Super FA Display Material (RA-4) (N)	**80 (–C)** [<10% RH] **70 (–C)** [70% RH]
Fujitrans Display Material (EP-2) (N)	**60 (–C)** [<10% RH] **50 (–C)** [70% RH]
Fujichrome Paper Type 35 (R-3) (T) **Fujichrome Copy Paper Type 35H** **Fujichrome Printing Material** [polyester] ("Fujichrome Super Deluxe Prints") [polyester] (1992—)	**120 (–C)** [<10% RH] **100 (–C)** [70% RH]
Fujichrome Paper Type 34 (R-3) (T) Fujichrome Copy Paper Type 34H Fujichrome Printing Material [polyester] ("Fujichrome Super Deluxe Prints") [polyester] (1986–92)	120 (–C) [<10% RH] 100 (–C) [70% RH]
Fujichrome Reversal Paper Type 33 (R–3) (T) (1983–86)	25 (–C) [<10% RH] 20 (–C) [70% RH]

Table 5.11 (continued from previous page)

(N) = For printing color negatives
(T) = For printing color transparencies
(T+N) = For printing either transparencies or negatives

Color Papers:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
Fuji CB Prints (T) (Ilford Ilfochrome materials supplied under the Fuji name in Japan) (1970—)	**(see Ilford Ilfochrome data in Table 5.12)**
Fuji Dyecolor Prints (dye transfer type) (T+N) (1970—) (available only in Japan)	**(not disclosed)***
Fuji-Inax Photocera Color Photographs (T+N) (fired pigment color process with ceramic support) (Fuji-Inax Ceramic Color Process) (1991—) (initially available only in Japan)	**"quasi-eternal"**
Fuji Colorcopy Paper AP (direct positive paper) (T) (Fuji AP-NM, AP-SG, AP-SGR, and AP-T materials for Fuji Colorcopy AP System) (1988—)	**100 (–C)** [<10% RH] **80 (–C)** [70% RH]
Fuji Colorcopy Paper AP (negative print paper) (N) (Fuji AP-NP and AP-NPR materials for Fuji Colorcopy AP System) (1988—)	**80 (–C)** [<10% RH] **70 (–C)** [70% RH]
Fuji Pictrography Color Prints (T+N) (silver-sensitized hybrid thermal dye transfer process for printing digitized color images) (1990—)	**(not disclosed)**
Instant Color Prints:	
Fuji FI-10 and Fuji 800 Instant Color Prints (1981— for Fuji FI-10; 1984— for Fuji 800) (available only in Japan)	**(not disclosed)**
Process C-41 Compatible Color Negative Films:	
Fujicolor Super G 100 Film **Fujicolor Super G 200 Film** **Fujicolor Super G 400 Film** (1992—)	**stability is "similar" to Fujicolor Super HG films**
Fujicolor Super HG 100 Film Fujicolor Super HG 200 Film Fujicolor Super HG 400 Film **Fujicolor Super HG 1600 Film** (1990— for Super HG 1600; 1989–92 for other films)	**70 (–C)** [<10% RH] **20 (–Y)** [70% RH]

Process C-41 Compatible Color Negative Films:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
Fujicolor Reala Film (ISO 100) (1989—)	**70 (–C)** [<10% RH] **20 (–Y)** [70% RH]
Fujicolor HG 400 Professional Film (1991—)	**70 (–C)** [<10% RH] **20 (–Y)** [70% RH]
Fujicolor 160 Professional Film S **Fujicolor 160 Professional Film L** **Fujicolor HR Disc Film**	**stability is "similar" to Fujicolor Super HG films**
Fujicolor Super HR 100 Film Fujicolor Super HR II 100 Film Fujicolor Super HR 200 Film Fujicolor Super HR 400 Film Fujicolor Super HR 1600 Film Fujicolor Super HR II 1600 Film	70 (–C) [<10% RH] 20 (–Y) [70% RH]
Fujicolor HR 100 Film Fujicolor HR 200 Film Fujicolor HR 400 Film	14 (–C) [<10% RH] 9 (–C) [70% RH]
Fujicolor HR 1600 Film	20 (–C) [<10% RH] 15 (–Y) [70% RH]
Fujicolor Internegative Film IT-N (1988—)	**70 (–C)** [<10% RH] **20 (–Y)** [70% RH]
Process E-6 Compatible Color Transparency Films:	
Fujichrome Velvia Professional Film (ISO 50) (1990—)	**150 (–Y)** [<10% RH] **40 (–C)** [70% RH]
Fujichrome 50D Film **Fujichrome 64T Film** **Fujichrome 100D Film** Fujichrome 400D Film (1984–92) **Fujichrome 400D Film** (improved type: 1992—) **Fujichrome 1600D Film** **Fujichrome Duplicating Films** (1983/88/92—)	**150 (–C)** [<10% RH] **40 (–C)** [70% RH]

* This author's tests indicate that the dark stability of Fuji Dyecolor prints is extremely good and is similar to that of Kodak Dye Transfer prints (i.e., longer than 600 years at 75°F [24°C] and 40% RH; see Table 5.13). Also like Dye Transfer prints, Fuji Dyecolor prints are essentially free from stain formation, even after prolonged storage in the dark or display under adverse conditions.

Table 5.12 Predicted Dark Fading Stability of Ilford Color Print Materials, Color Negative Films, and Slide Films (from Data Supplied by Ilford and Based on Arrhenius Accelerated Dark Fading Tests)

Estimated Storage Time for a 20% Loss of the Least Stable Image Dye for Storage in the Dark at 75°F (24°C)

(Note: Predictions Are For Storage at 40% RH)

Boldface Type indicates products that were being marketed in the U.S. and/or other countries when this book went to press in 1992; the other products listed had been either discontinued or replaced with newer materials. Ilford is a subsidiary of the International Paper Company, an American company headquartered in Purchase, New York. These estimates are based on initial cyan, magenta, and yellow densities of 1.0 with full d-min corrected densitometry. Unlike chromogenic materials, Ilfochrome prints and microfilms (called Cibachrome prints and microfilms, 1963–91) can be expected to remain virtually free of stain even after prolonged storage.

Silver Dye-Bleach Materials for Printing Color Transparencies:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
Ilfochrome Classic Deluxe Print Material (CPS.1K) Cibachrome II Print Material (CPS.1K) [high-contrast, high-gloss polyester-base material] (Process P-3, P-3X, P-30, and P-30P) (Cibachrome II: 1980–91) (Ilfochrome Classic: 1991—)	**"more than 500" ***
Ilfochrome Classic Deluxe Print Material (CM.1K) [medium-contrast, high-gloss polyester-base material] (Process P-3, P-3X, P-30, and P-30P) (1992—)	**"more than 500" ***
Ilfochrome Classic Deluxe Print Material (CF.1K) Cibachrome II Print Material (CF.1K) [low-contrast, high-gloss polyester-base material] (Process P-3, P-3X, P-30, and P-30P) (Cibachrome II: 1980–91) (Ilfochrome Classic: 1991—)	**"more than 500" ***
Cibachrome II Print Material (CRC.44M) ["Pearl" semi-gloss RC paper] (Process P-3, P-3X, P-30, and P-30P) (Cibachrome II: 1980–92)	"more than 500" *
Ilfochrome Classic Print Material (CPM.1M) [medium-contrast glossy RC paper] (Process P-3, P-3X, P-30, and P-30P) (1992—)	**"more than 500" ***
Ilfochrome Classic Print Material (CPM.44M) [medium-contrast "Pearl" semi-gloss RC paper] (Process P-3, P-3X, P-30, and P-30P) (1992—)	**"more than 500" ***
Ilfochrome Classic Print Material (CPH.1M) [high-contrast glossy RC copy paper] (Process P-3, P-3X, P-30, and P-30P) (1992—)	**"more than 500" ***

Silver Dye-Bleach Materials for Printing Color Transparencies:	Estimated Years of Dark Storage 20% Loss of Least Stable Dye
Ilfochrome Classic Translucent Display Film (CT.F7) Cibachrome II Display Film, Translucent Base (CL.F7) [for back-lighted displays] (Process P-3, P-3X, P-30, and P-30P) (1980–92 for Cibachrome Display Films; 1992— for Ilfochrome)	**"more than 500" ***
Ilfochrome Classic Clear Display Film (CC.F7) Cibachrome II Display Film, Transparent Base (CTD.F7) [for back-lighted displays] (Process P-3, P-3X, P-30, and P-30P)	**"more than 500" ***
Ilfochrome Classic Clear Display (OHP) Film (COH.F7) Cibachrome II Overhead Transparency Film (COHP.F7) [for overhead transparencies and back-lighted displays] (Process P-3, P-3X, P-30, and P-30P)	**"more than 500" ***
Ilfochrome Rapid Deluxe Print Material (RLL.1K) [high-gloss polyester-base material] (1991—) (Process P-22 and P-4)	**"more than 500" ***
Ilfochrome Rapid Print Material (RPL.1M) [glossy RC paper] (1991—) (Process P-22 and P-4)	**"more than 500" ***
Ilfochrome Rapid Print Material (RPL.44M) ["Pearl" semi-gloss RC paper] (1991—) (Process P-22 and P-4)	**"more than 500" ***
Ilfochrome Rapid Print Material (CCO.1M) [high-contrast glossy RC copy paper] (1991—) (Process P-22 and P-4)	**"more than 500" ***
Ilfochrome Rapid Print Material (CCO.1K) [high-contrast glossy polyester-base copy material] (1991—) (Process P-22 and P-4)	**"more than 500" ***

Table 5.12 (continued from previous page)

Silver Dye-Bleach Materials for Printing Color Transparencies:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
Ilfochrome Rapid Print Material (CCO.44M) ["Pearl" semi-gloss high-contrast RC copy paper] (1991—) (Process P-22 and P-4)	**"more than 500" ***
Ilfochrome Rapid Print Material (CCO.44L) [lightweight "Pearl" semi-gloss high-contrast RC copy paper] (1991—) (Process P-22 and P-4)	**"more than 500" ***
Ilfochrome Rapid OHP Film (CTR.F7) [overhead transparency film] (1991—) (Process P-22 and P-4)	**"more than 500" ***
Cibacopy RC Papers and Polyester-Base Print Materials [processed in Ilford Cibacopy and Ilfochrome Rapid Systems KP-30/40, CC-1217Z/E, CC-1012, CC-120/180, as well as other systems employing P-17, P-22, P-222, and P-4 chemicals] (1976–91)	"more than 500" *
Cibachrome-A II Print Material (CPSA.1K) [high-gloss polyester-base print material] (Process P-30 and P-30P) (1981–89 for "initial type") (1989–91 for "improved type")	"more than 500" *
Cibachrome-A II Print Material (CRCA.44M) ["Pearl" semi-gloss RC paper] (Process P-30 and P-30P) (1981–89 for "initial type") (1989–91 for "improved type")	"more than 500" *
Cibachrome-A II Print Material (CF.1K) [low-contrast, high-gloss polyester material] (Process P-30 and P-30P)	"more than 500" *
Silver Dye-Bleach Color Microfilm:	
Ilfochrome Micrographic Film Type M & Type P Cibachrome Micrographic Film Type M & Type P [high-resolution color microfilms] (Process P-5) (1984—)	**"more than 500" ***
Chromogenic Materials for Printing Color Negatives:	
Ilford Ilfocolor Deluxe Print Material (ILRA.1K) (RA-4) (high-gloss polyester-base print material manufactured by Ilford in Switzerland using emulsion components supplied by Konica; the stability of the Ilford product is believed to be similar if not identical to Konica Color QA Super Glossy Print Material Type A3 — see Table 5.5a and Table 5.15) (1991—)	**(not disclosed)**

Chromogenic Materials for Printing Color Negatives:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
Ilford Colorluxe Print Material (SP-729s) (RA-4) (high-gloss polyester-base print material manufactured by Ilford in Switzerland using emulsion components supplied by Konica; the stability of the Ilford product is believed to be similar if not identical to Konica Color QA Super Glossy Print Material Type A2 — see Table 5.5c and Table 5.15) (1990–91)	(not disclosed)
Ilford Colorluxe Print Material (IL.1K) (EP-2) (high-gloss polyester-base print material manufactured by Ilford in Switzerland using emulsion components supplied by Konica; the stability of the Ilford product is believed to be similar if not identical to Konica Color Type SR [SG] print material — see Table 5.5b and Table 5.15) (1990—)	**(not disclosed)**
Ilford Ilfocolor Deluxe Translucent Display Film (ITRA.F7) (RA-4) (translucent, polyester-base display material manufactured by Ilford in Switzerland using emulsion components supplied by Konica; the stability of the Ilford product is believed to be similar if not identical to Konica Color Trans QA Display Film Type A3 — see Table 5.15) (1992—)	**(not disclosed)**
Chromogenic Color Negative and Color Slide Films:	
Ilford Ilfocolor HR 100 Film (C-41)	(not disclosed) **
Ilford Ilfocolor HR 200 Film (C-41)	(not disclosed) **
Ilford Ilfocolor HR 400 Film (C-41)	(not disclosed) **
Ilford Ilfochrome 50 Film (E-6)	(not disclosed) ***
Ilford Ilfochrome 100 Film (E-6)	(not disclosed) ***
Ilford Ilfochrome 200 Film (E-6)	(not disclosed) ***

* This author's accelerated tests conducted at 62°C (144°F) and 45% RH suggest that Ilfochrome (Cibachrome) images are essentially permanent in dark storage — they are probably even more stable than Kodak Dye Transfer prints (i.e., longer than 600 years for a 20% density loss of the least stable dye when stored at 75°F [24°C] — see Table 5.13). Like Dye Transfer prints, Ilfochrome polyester-base prints remain virtually free from stain formation — even after prolonged storage in the dark or display under adverse conditions (Ilfochrome RC-base prints, however, can develop yellowish stain after exposure to light during extended display).

** These now-discontinued Ilford Ilfocolor HR color negative films were made for Ilford by Agfa-Gevaert in Germany and are believed to have stability characteristics identical to Agfacolor XR films of the same ISO rating (see Table 5.10); these Ilfocolor film were marketed from March 1987 until May 1988. Prior to 1987 Ilfocolor films are believed to have been supplied to Ilford by Konica.

*** These now-discontinued Ilford Ilfochrome transparency films were made for Ilford by Agfa-Gevaert in Germany and are believed to have stability characteristics that are identical to Agfachrome CT films of the same ISO ratings (see Table 5.10); these Ilfochrome films were marketed by Ilford from March 1987 until May 1988. Prior to 1987 Ilfochrome films are believed to have been supplied to Ilford by Konica.

Table 5.13 Predicted Dark Fading Stability of Kodak Color Print Materials, Color Negatives, and Transparencies (Compiled from Published Kodak Data and Based on Arrhenius Accelerated Dark Fading Tests)

Estimated Storage Time for a 20% Loss of the Least Stable Image Dye for Storage in the Dark at 75°F (24°C)

(Note: Predictions Are for Storage at 40% RH)

Boldface Type indicates products that were being marketed in the U.S. and/or other countries when this book went to press in 1992; the other products listed had been either discontinued or replaced with newer materials. These estimates are based on initial cyan, magenta, and yellow densities of 1.0 with full d-min corrected densitometry. These estimates are for dye fading only and do not take into account the gradual formation of yellowish stain. With print materials in particular (e.g., Ektacolor papers), the level of stain may become objectionable before the least stable image dye has faded 20%.

(N) = For printing color negatives
(T) = For printing color transparencies
(T+N) = For printing either transparencies or negatives
(I) = Instant camera print

Color Print Materials:	Estimated Years of Dark Storage for 20% Loss of Least Stable Image Dye
Kodak Dye Transfer Prints [fiber-base] (T+N) (Obsolete MX-1119 special-order yellow dye available in the early 1980's.)	>1,000 (—)
Kodak Dye Transfer Prints [fiber-base] (T+N) (Prints made with "standard" Kodak Film and Paper Dyes.)	**>600 (–Y)**
Kodak Dye Transfer Prints [fiber-base] (T+N) (Kodak MX-1372 Yellow Dye trade-tested in 1989 and "standard" Kodak Magenta and Cyan Film and Paper Dyes; MX-1372 Yellow Dye was withdrawn in 1990.)	(not disclosed)
Trimprint Instant Color Film (I)	>400 (–M)
Kodak Instant Color Film — Trimprint (I)	>400 (–M)
Kodamatic Instant Color Film — HS 144-10 (I)	>400 (–M)
Kodak Instant Color Film — PR 144-10 (I)	>300 (–M)
Ektaflex PCT Color Prints (1981–88) (T+N)	160 (–M)
Ektacolor Plus Paper (EP-2) (N) **Ektacolor Professional Paper** **Ektacolor Plus Thin Paper** ("Ektacolor Print") ("Kodalux Print") (formerly "Kodacolor Print")	**76 (–Y)**
Duraflex Print Material 4023 [improved] (EP-2) (N)	**[76 (–Y)]**
Duratrans Display Material 4022 [improved] (EP-2) (N)	**[76 (–Y)]**

(N) = For printing color negatives
(T) = For printing color transparencies
(T+N) = For printing either transparencies or negatives
(I) = Instant camera print

Color Print Materials:	Estimated Years of Dark Storage for 20% Loss of Least Stable Image Dye
Ektacolor Edge Paper (RA-4 with water wash) (N) **Ektacolor Royal II Paper** **Ektacolor Portra II Paper** **Ektacolor Supra Paper** **Ektacolor Ultra Paper** **Duraflex RA Print Material** [polyester] **Duratrans RA Display Material** **Ektatrans RA Display Material** **Duraclear RA Display Material** Ektacolor 2001 Paper Ektacolor Royal Paper Ektacolor Portra Paper ("Ektacolor Print") ("Kodalux Print")	**(not disclosed)**
Ektacolor Edge Paper (RA-4NP with "washless" stabilizer) (N) **Ektacolor Royal II Paper** **Ektacolor Portra II Paper** **Ektacolor Supra Paper** **Ektacolor Ultra Paper** **Duraflex RA Print Material** [polyester] **Duratrans RA Display Material** **Ektatrans RA Display Material** **Duraclear RA Display Material** Ektacolor 2001 Paper Ektacolor Royal Paper Ektacolor Portra Paper ("Ektacolor Print") ("Kodalux Print")	**(not disclosed)**

Table 5.13 (continued from previous page)

(N) = For printing color negatives
(T) = For printing color transparencies
(T+N) = For printing either transparencies or negatives
(I) = Instant camera print

Color Print Materials:	Estimated Years of Dark Storage for 20% Loss of Least Stable Image Dye
Ektachrome Radiance Paper (1991—) (R-3) (T)	**(not disclosed)**
Ektachrome Radiance Select Material (1991—) [polyester]	
Ektachrome Radiance HC Copy Paper (1992—)	
Ektachrome Radiance Thin Copy Paper (1992—)	
Ektachrome 22 Paper [improved type: 1990–91] (R-3) (T)	(not disclosed)
Kodak Ektatherm Color Print Paper (1990—) (thermal dye transfer paper used with Kodak XL 7700-series Digital Continuous Tone Printers)	**(not disclosed)**
Kodak Thermacolor Electronic Print Paper (1989—) (thermal dye transfer paper used with Hitachi Video Printer)	**(not disclosed)**
Ektacolor 37 RC Paper (EP-3 w/stabilizer) (N) (“Ektacolor Print”) (“Kodacolor Print”)	20 (–C)
Ektachrome 14 Paper (R-100) (T)	20 (–C)
Duratrans Display Material 4022 (EP-2) (N)	18 (–C)
Ektacolor 74 RC Paper (EP-2) (N)	16 (–C)
Ektacolor 78 Paper (“Ektacolor Print”) (“Kodacolor Print”)	
Ektachrome Copy Paper (R-3) (T)	**16 (–C)**
Ektachrome HC Copy Paper	
Ektachrome Overhead Material	
Ektachrome Prestige Paper (1986–1991) [polyester]	
Ektachrome 22 Paper (initial type: 1984–90)	
Ektachrome 2203 Paper (R-100) (T)	15 (–C)

Color Negative and Internegative Films (C-41):	
Vericolor III Professional Film, Type S	**38 to 65 (–Y)**
Ektacolor Gold 160 Professional Film	
Ektacolor GPF 160 Professional Film (In the U.S., Ektacolor GPF is sold only in 8-exposure 35mm rolls)	
Vericolor 400 Professional Film	**38 to 65 (–Y)**
Ektacolor Gold 400 Professional Film	
Vericolor HC Professional Film	**16 to 28 (–Y)**
Vericolor Copy/ID Film	**38 to 65 (–Y)**

(N) = For printing color negatives
(T) = For printing color transparencies
(T+N) = For printing either transparencies or negatives
(I) = Instant camera print

Color Negative and Internegative Films (C-41):	Estimated Years of Dark Storage for 20% Loss of Least Stable Image Dye
Ektapress Gold 100 Professional Film	**16 to 28 (–Y)**
Ektapress Gold 400 Professional Film	**38 to 65 (–Y)**
Ektapress Gold 1600 Professional Film	**38 to 65 (–Y)**
Ektar 25 Film and Ektar 25 Professional Film	**16 to 28 (–Y)**
Ektar 100 Film	**(not disclosed)**
Ektar 125 Film	16 to 28 (–Y)
Ektar 1000 Film	**38 to 65 (–Y)**
Kodacolor HR Disc Film	43 (–Y)
Kodak Gold Disc Film (1991—)	
Kodacolor Gold Disc Film	**(not disclosed)**
Kodacolor VR Disc Film	
Kodacolor VR 100 Film	
Kodacolor VR 200 Film	**35 (–Y)**
Kodacolor VR 400 Film (1983—)	
Kodacolor VR 1000 Film	33 (–Y)
Kodacolor Gold 100 Film (1986–91) (formerly Kodacolor VR-G 100 Film)	26 (–Y)
Kodak Gold 100 Film (1991–92)	
Kodacolor Gold 200 Film (1986–91) (formerly Kodacolor VR-G 200 Film)	16 to 28 (–Y)
Kodak Gold 200 Film (1991–92)	
Kodacolor Gold 400 Film (1988–91) (formerly Kodacolor VR-G 400 Film)	38 to 65 (–Y)
Kodak Gold 400 Film (1991–92)	
Kodak Gold Plus 100 Film (1992—)	**(not disclosed)**
Kodak Gold II 100 Film (name in Europe)	
Kodak Gold Plus 200 Film (1992—)	**(not disclosed)**
Kodak Gold II 200 Film (name in Europe)	
Kodak Gold Plus 400 Film (1992—)	**(not disclosed)**
Kodak Gold II 400 Film (name in Europe)	
Kodak Gold 1600 Film (1991—)	**38 to 65 (–Y)**
Kodacolor Gold 1600 Film (1989–91)	

(Table 5.13 continued on following page . . .)

Table 5.13 (continued from previous page)

Color Negative and Internegative Films (C-41):	Estimated Years of Dark Storage for 20% Loss of Least Stable Image Dye
Kodacolor 400 Film	22 (–C)
Kodacolor II Film	14 (–C)
Vericolor II Professional Film, Type S	14 (–C)
Vericolor Internegative Film 6011	**12 (–C)**
Kodak Commercial Internegative Film (1993—)	**(not disclosed)**
Vericolor Internegative Film 4114 (1984–93)	**(not disclosed)**
Vericolor II Professional Film, Type L	**7 (–C)**
Vericolor II Commercial Film, Type S	7 (–C)
Process K-14 Kodachrome Films:	
Kodachrome 25 and 25 Professional Films	
Kodachrome 40 Film 5070 (Type A)	**185 (–Y)**
Kodachrome 64 and 64 Professional Films	
Kodachrome 200 and 200 Professional Films	
Process E-6 Ektachrome Films ("Group II" films introduced beginning in 1988):	
Ektachrome 100 Plus Professional Film	
Ektachrome 100 HC Film	
Ektachrome 50 HC Film	**220 (–C)**
Ektachrome 64T Professional Film (Tungsten)	
Ektachrome 320T Professional Film (Tungsten)	
Ektachrome 64X Professional Film	
Ektachrome 100X Professional Film	
Ektachrome 400X Professional Film	
Ektachrome 400 HC Film	
Process E-6 Ektachrome Films ("Group I" films introduced beginning in 1978):	
Ektachrome 50 Professional Film (Tungsten)	
Ektachrome 50 Professional Film, 5018 (Tungsten)	
Ektachrome 50 Professional Film, 6018 (Tungsten)	**105 (–Y)**
Ektachrome 64 Film	
Ektachrome 64 Professional Film	
Ektachrome 64 Professional Film, 5017	
Ektachrome 64 Professional Film, 6117	
Ektachrome 64 EPV Film (Press and Video Film)	
Ektachrome 100 Film	
Ektachrome 100 Professional Film	
Ektachrome 160 Film (Tungsten)	

Process E-6 Ektachrome Films ("Group I films):	Estimated Years of Dark Storage for 20% Loss of Least Stable Image Dye
Ektachrome 160 Professional Film (Tungsten)	
Ektachrome 160 Professional Film, 5037 (Tungsten)	
Ektachrome 200 and 200 Professional Film	**105 (–Y)**
Ektachrome 200 Professional Film, 5036	
Ektachrome 200 Professional Film, 6176	
Ektachrome 400 Film	
Ektachrome P800/1600 Professional Film	
Ektachrome Slide Duplicating Film 5071	
Ektachrome SE Duplicating Film SO-366	
Ektachrome Slide Duplicating Film, Type K	
Ektachrome Duplicating Film 6121	
Process E-3 and E-4 Ektachrome Films:	
Ektachrome Infrared Film 2236 (E-4)	**42 (–C)**
High Speed Ektachrome Film (E-4)	
High Speed Ektachrome Film Type B (Tungsten)	30 (–C)
Ektachrome-X Film	
Ektachrome Professional Films (E-3) (sheet and 120 roll films: 1959–77)	8 (–C)
Kodak Photomicrography Color Film 2483 (E-4)	6 (–Y)
Print Films for Making Slides from Negatives or Internegatives:	
Eastman Color Print Film 5384 (slide from negative)	**88 (–Y)**
Vericolor Slide Film 5072 (slide from negative)	**18 (–Y)**
Vericolor Print Film 4111 (transparency from negative)	**18 (–Y)**
Eastman Color SP Print Film 5383 (slide from negative)	9 (–C)

Note: The estimates given here have been derived from data in **Evaluating Dye Stability of Kodak Color Products**, Kodak Publication No. CIS-50, January 1981, and subsequent CIS-50 series of dye-stability data sheets through 1985; **Image-Stability Data: Kodachrome Films**, Kodak Publication E-105, 1988; **Image-Stability Data: Kodak Ektachrome Films**, Kodak Publication E-106, 1988; **Image-Stability Data: Kodak Color Negative Films (Process C-41)**, Kodak Publication E-107, June 1990; **Evaluating Image Stability of Kodak Color Photographic Products**, Kodak Publication No. CIS-130, March 1991; **Kodak Ektacolor Plus and Professional Papers for the Professional Finisher**, Kodak Publication No. E-18, March 1986; **Dye Stability of Kodak and Eastman Motion Picture Films** (data sheets); Kodak Publications DS-100-1 through DS-100-9, May 29, 1981; and other published and non-published Kodak sources. The estimate for Process E-3 Ektachrome films is from an article by Charleton Bard et al, (Eastman Kodak) entitled "Predicting Long-Term Dark Storage Dye Stability Characteristics of Color Photographic Products from Short-Term Tests," **Journal of Applied Photographic Engineering**, Vol. 6, No. 2, April 1980, p. 44. The accelerated-test data given in the article were for Ektachrome Duplicating Film 6120 (Process E-3) and is assumed to apply to Process E-3 Ektachrome camera films; Kodak has declined to release dye-stability data for these films.

Table 5.14 Unpublished Kodak Estimates of Dark Fading Stability for Kodak Color Materials (Applicable to Kodak Products Marketed from About 1960 Through 1977)

Estimated Storage Time for 10% Loss of the Least Stable Image Dye for Storage in the Dark at 75°F (24°C)
(Note: Predictions Are for Storage at 40% RH)

Note: These estimates are for a "just noticeable" 10% loss of the least stable image dye. To compare these data with those in other tables in this chapter, which present estimates for a 20% loss of dye density, the storage times given below should be multiplied by a factor of 2.3. (With many products, the dark fading curve is reasonably linear as fading progresses to the point of a 20% dye loss, and a simple multiple of 2x will be reliable. However, with some products the rate of fading gradually decreases as dark fading progresses, and a 20% density loss will take more than twice the storage time required for a 10% loss.)

The Process E-6 Ektachrome Professional films listed below were the initial versions manufactured in 1976; later versions of the films were significantly improved in dark fading stability, and it is believed that by the end of 1978 or early in 1979 all Kodak Process E-6 Ektachrome professional and amateur films had the same, improved stability. Kodak has not revealed when the improvements were made in each particular type of Ektachrome film, although it has been reported that Ektachrome Slide Duplicating Film 5071 was the first to be marketed with an improved dark fading stability.

These estimates are based on initial cyan, magenta, and yellow densities of 1.0 with full d-min corrected densitometry. These estimates are for dye fading only and do not take into account the gradual formation of yellowish stain. With print materials in particular (e.g., Kodak Ektacolor papers), the level of stain may become objectionable before the least stable image dye has faded 10%.

21 to 50 Years:

Kodachrome II Film (Daylight) [Process K-12]
Kodachrome II Professional Film, Type A [Process K-12]
Kodachrome-X Film [Process K-12]
Kodachrome II Movie Film (Daylight) [Process K-12]
Kodachrome II Movie Film (Type A) [Process K-12]

11 to 20 Years:

Ektachrome 160 Professional Film 5037 (Tungsten) [Process E-6]
Ektachrome Duplicating Film 6121 [Process E-6]
Ektachrome Slide Duplicating Film 5071 [Process E-6]
Ektachrome-X Film [Process E-4]
High-Speed Ektachrome Film (Daylight) [Process E-4]
High-Speed Ektachrome Film (Tungsten) [Process E-4]
Ektachrome EF Film 7241 (Daylight) [Process ME-4]
Ektachrome EF Film 7242 (Tungsten) [Process ME-4]
Ektachrome MS Film 7256 [Process ME-4]

6 to 10 Years:

Ektachrome 50 Professional Film 5018 and 6118 (Tungsten) [Process E-6]
Ektachrome 64 Professional Film 5017 and 6117 (Daylight) [Process E-6]
Ektachrome 200 Professional Film 5036 (Daylight) [Process E-6]
Ektacolor Slide Film 5028 [Modified Process C-22]
Ektacolor Print Film 4109 [Modified Process C-22]

6 to 10 Years (continued):

Ektacolor 37 RC Paper ("Kodacolor Print") [Process EP-3]
Ektachrome RC Paper, Type 1993 [Process R-5]
Eastman Color Negative II Film 5247 (1976 improved version) [Process ECN-2]

Less Than 6 Years:

Ektachrome Film 6115, Daylight Type [Process E-3]
Ektachrome Film 6116, Type B [Process E-3]
Ektachrome Professional Film (Daylight) EP120 [Process E-3]
Ektachrome Professional Film, Type B (Tungsten) EPB120 [Process E-3]
Ektachrome Duplicating Film 6120 [Process E-3]
Ektachrome Slide Duplicating Film 5038 [Process E-4]
Vericolor S Film [Vericolor Process]
Vericolor L Film [Vericolor Process]
Vericolor II Film, Type S (original version) [Process C-41]
Vericolor II Film, Type L [Process C-41]
Kodacolor-X Film [Process C-22]
Ektacolor Professional Film, Type S [Process C-22]
Ektacolor Professional Film 6101, Type S [Process C-22]
Ektacolor Professional Film 6102, Type L [Process C-22]
Ektacolor Internegative Film 6008 and 6110 [Modified Process C-22]
Eastman Color Negative Film 5254 and 7254 [Process ECN]
Eastman Color Negative II Film 5247 and 7247 (orig. versions) [Process ECN-2]
Eastman Color Print Film 5381 and 7381 [Process ECP]
Ektachrome 40 Movie Film 7262 [Process EM-25]

Table 5.15 Predicted Dark Fading Stability of Konica Color Print Materials, Color Negatives, and Transparencies (from Data Supplied by Konica and Based on Arrhenius Accelerated Dark Fading Tests)

Estimated Storage Time for a 20% Loss of the Least Stable Image Dye for Storage in the Dark at 75°F (24°C)

(Note: Predictions Are for Storage at 60% RH)

Boldface Type indicates products that were being marketed in the U.S., Japan, and/or other countries when this book went to press in 1992; the other products listed had been either discontinued or replaced with newer materials. These estimates are based on initial cyan, magenta, and yellow densities of 1.0 with full d-min corrected densitometry. These estimates are for dye fading only and do not take into account the gradual formation of yellowish stain. With print materials in particular (e.g., Konica Color Paper Type SR and Type A3), the level of stain may become objectionable before the least stable image dye has faded 20%.

(N) = For printing color negatives
(T) = For printing color transparencies

Color Papers and Display Films:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
Konica Color QA Paper Type A5 (RA-4) (N) (Konica Color "Century Paper" or "Century Print") (Konica Color "Long Life 100 Print") (RA-4 compatible paper processed with Konica CPK-20QA chemicals and water wash) (1990—) (initially available only in Japan)	**160–200 (–C)**
Konica Color QA Paper Type A5 (RA-4) (N) (Konica Color "Century Paper" or "Century Print") (Konica Color "Long Life 100 Print") (RA-4 compatible paper processed with Konica CPK-20QA chemicals and Konica Super Stabilizer in Konica washless minilab) (1990—) (initially available only in Japan)	**(not disclosed)**
Konica Color QA Paper Type A3 (RA-4) (N) **Konica Color QA Paper Professional Type X2** **Konica Color QA Super Glossy Print Material Type A3** [polyester] **Konica Color QA Paper Peelable Type A3** (Konica Color "Century Paper" or "Century Print") (Konica Color "Long Life 100 Print") (RA-4 compatible paper processed with Konica CPK-20QA chemicals and water wash) (1991—)	**160–200 (–C)**
Konica Color QA Paper Type A3 (RA-4) (N) **Konica Color QA Paper Professional Type X2** **Konica Color QA Super Glossy Print Material Type A3** [polyester] **Konica Color QA Paper Peelable Type A3** (Konica Color "Century Paper" or "Century Print") (Konica Color "Long Life 100 Print") (RA-4 compatible paper processed with Konica CPK-20QA chemicals and Konica Super Stabilizer in Konica washless minilab) (1991—)	**(not disclosed)**
Konica Color QA Paper Type A2 (RA-4) (N) **Konica Color QA Paper Professional Type X1** **Konica Color QA Super Glossy Print Material Type A2 [polyester]** **Konica Color QA Paper Peelable Type A2** **Konica Color QA Paper Type A** (Konica Color "Century Paper" or "Century Print") (Konica Color "Long Life 100 Print") (RA-4 compatible paper processed with Konica CPK-20QA chemicals and Konica Super Stabilizer in Konica washless minilab) (1988/90—)	**80 (–C)**
Konica Color QA Paper Type A2 (RA-4) (N) **Konica Color QA Paper Professional Type X1** **Konica Color QA Super Glossy Print Material Type A2 [polyester]** **Konica Color QA Paper Peelable Type A2** **Konica Color QA Paper Type A** (Konica Color "Century Paper" or "Century Print") (Konica Color "Long Life 100 Print") (RA-4 compatible paper processed with Konica CPK-20QA chemicals and water wash) (1988/90—)	**70 (–C)**
Konica Color PC Paper Type SR (EP-2) (N) **Konica Color PC Paper Professional Type EX** **Konica Color PC Paper Type SR (SG)** [polyester] **Konica Color PC Paper Peelable Type SR** (Konica Color "Century Paper" or "Century Print") (Konica Color "Long Life 100 Print") (EP-2 compatible paper processed with Konica CPK-18 chemicals and Konica Super Stabilizer in Konica washless minilab) (1984/88—)	**80 (–C)**

Table 5.15 (continued from previous page)

Color Papers and Display Films:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
Konica Color PC Paper Type SR (EP-2) (N) **Konica Color PC Paper Professional Type EX** **Konica Color PC Paper Type SR (SG)** [polyester] **Konica Color PC Paper Peelable Type SR** (Konica Color "Century Paper" or "Century Print") (Konica Color "Long Life 100 Print") (EP-2 compatible paper processed with Konica CPK-18 chemicals and water wash) (1984/88—)	**70 (–C)**
Konica Color Trans QA Display Film Type A3 (RA-4) (N) (translucent polyester-base version of Type A3 paper) **Konica Color Clear QA Display Film Type A3** (clear polyester-base version of Type A3 paper) (1992—)	**120–140 (–Y)**
Konica Color Trans Display Film Type SR (EP-2) (N) (translucent polyester-base version of Type SR paper) **Konica Color Clear Display Film Type SR** (clear polyester-base version of Type SR paper) (1988—)	**70 (–C)**
Konica Chrome Paper Type 81 (R-3) (T) (1989—)	**160–200 (–C)**
Process C-41 Compatible Color Negative Films:	
Konica Color Impresa 50 Professional Film (1991—)	**20 (–Y)**
Konica Color Super SR 100 Film **Konica Color Super SR 200 Film** **Konica Color Super SR 400 Film** (1990—)	**13 (–Y)** **13 (–Y)** **15 (–Y)**
Konica Color Super DD 100 Film **Konica Color Super DD 200 Professional Film** **Konica Color Super DD 400 Film** (1990—)	**13 (–Y)** **13 (–Y)** **15 (–Y)**
Konica Color XG400 Film (1992—) (initially available only in Japan)	**(not disclosed)**
Konica Color Super SR 200 Film (USA market) **Konica Color Super SR 200 Professional Film** (1990—)	**22 (–Y)** **22 (–Y)**
Konica Color Professional 160 Film Type S **Konica Color Professional 160 Film Type L** (1990—)	**(not disclosed)**

Process C-41 Compatible Color Negative Films:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
Konica Color SR-G 100 Film Konica Color GXII 100 Film Konica Color SR-G 200 Film Konica Color SR-G 400 Film (1989–90)	(not disclosed)
Konica Color SR-G 160 Professional Film (1989—)	**(not disclosed)**
Konica Color SR-G 3200 Professional Film (new name: 1989—) **Konica Color GX3200 Professional Film** (new name: 1989—) Konica Color SR-V 3200 Professional Film (1987–89)	**13 (–Y)**
Konica Color SR-V 100 Film	33 (–C)
Konica Color GX100 Film	(not disclosed)
Konica Color SR-V 200 Film Konica Color GX200 Professional Film	13 (–Y)
Konica Color SR-V 400 Film Konica Color GX400 Film	14 (–Y)
Konica Color SR 100 Film Konica Color SR Professional Film Type S Konica Color SR 200 Film	9 (–C)
Konica Color SR 200 Film (improved type)	30 (–C)
Konica Color SR 400 Film	85 (–C)
Konica Color SR 1600 Film	89 (–C)
Process E-6 Compatible Color Transparency Films:	
Konica Chrome R-100 Film (1986—)	**115 (–C)**
Konica Chrome R-50 KF Film **Konica Chrome R-100 KS Film** **Konica Chrome R-200 KU Film** **Konica Chrome R-1000 KX Film** (1990—) (initially available only in Japan)	**115 (–C)** **115 (–C)** **48 (–Y)** **(not disclosed)**

Note: In Japan and some other countries, Konica Color films and papers were originally sold under the Sakuracolor brand name. In October 1987 the Sakuracolor name was dropped in favor of the Konica Color name in all markets, worldwide; at the same time the manufacturer, Konishiroku Photo Industries Co. Ltd., headquartered in Tokyo, Japan, changed its name to Konica Corporation.

Table 5.16 Predicted Dark Storage Stability of Polaroid Color Prints, Color Negatives, and Transparencies (Data Requested from Polaroid Were for Accelerated Tests, Non-Accelerated Tests, and/or Storage at Normal Room Temperature)

Estimated Storage Time for a 20% Loss of the Least Stable Image Dye and a 0.10 d-min Color Imbalance for Instant Materials Stored in the Dark at 75°F (24°C)

(Note: Predictions Were Requested for Storage at 40% RH)

Boldface Type indicates products that were being marketed in the U.S. and/or other countries when this book went to press in 1992; the other products listed had been either discontinued or replaced with newer materials.

Pigment Color Prints:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye or 0.10 d-min Color Imbalance
Polaroid Permanent-Color Print Materials (Materials for making extraordinarily stable pigment color prints; available on special order from Polaroid.) (1989—)	**(not disclosed)** (see Table 5.6)
Peel-Apart Polaroid Instant Prints:	
Polacolor Instant Prints (1963–75)	(not disclosed)
Polacolor 2 Instant Prints **(Types 88; 108; 668; 58; and 808)** (1975—)	**(not disclosed)**
Polacolor ER Instant Prints **(Types 59; 559; 669; and 809)** (1980—)	**(not disclosed)**
Polacolor 100 Instant Prints **Polacolor 64T Instant Prints** (1992—)	**(not disclosed)**
Polacolor Pro 100 Instant Prints (1993—)	**(not disclosed)**
Integral Polaroid Instant Prints:	
Polaroid SX-70 Instant Prints (1972–76)	(not disclosed)
Polaroid SX-70 Instant Prints (Improved) (1976–79)	(not disclosed)

Integral Polaroid Instant Prints:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye or 0.10 d-min Color Imbalance
Polaroid SX-70 Time-Zero Instant Prints (initial type: 1979–80)	(not disclosed)
Polaroid SX-70 Time-Zero Instant Prints **Polaroid Type 778 Time-Zero Prints** (improved type: 1980—)	**(not disclosed)**
Polaroid High Speed Type 779 Prints **Polaroid Autofilm Type 339 Prints** Polaroid 600 High Speed Instant Prints (1981—)	**(not disclosed)**
Polaroid Spectra Instant Prints (1986–91) Polaroid Image Prints (Spectra in Europe) **Polaroid 600 Plus Instant Prints** (1988—) **Polaroid Type 990 Prints** **Polaroid Autofilm Type 330 Prints**	**(not disclosed)**
Polaroid Spectra HD Instant Prints **Polaroid Image Prints** (Spectra HD in Europe) (1991—)	**(not disclosed)**
Polaroid Vision 95 Instant Prints (name in Europe) **Polaroid " ? " 95 Instant Prints** (name in Asia) **Polaroid " ? " 95 Instant Prints** (name in North & South America) (The internal structure of Vision 95 prints is basically the same as that of Spectra HD and 600 Plus prints; however, the rate of formation of yellowish stain that occurs over time in dark storage is said by Polaroid to be "somewhat reduced" compared with that of Spectra HD and 600 Plus prints. The names Polaroid will use for Vision 95 products in non-European markets were not available at the time this book went to press.) (1992— for Vision 95 products sold in Germany) (1993— for Asia, North and South America, and other markets)	**(not disclosed)**

Table 5.16 (continued from previous page)

Polaroid "Instant" 35mm Color Slide Films:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye or 0.10 d-min Color Imbalance
Polaroid PolaChrome 35mm Slide Film	**(not disclosed)**
Polaroid PolaChrome High Contrast 35mm Slide Film	**(not disclosed)**
Process C-41 Compatible Color Negative Films:	
Polaroid Supercolor 100 Print Film (Initial type made by Agfa for Polaroid and sold in Spain and Portugal.)	(not disclosed)
Polaroid OneFilm Color Print Film (ISO 200) (improved-stability type: 1990—) (Although the film is labeled by Polaroid as "Made in U.S.A.," it is actually manufactured in Italy by a subsidiary of the 3M Company.)	**(not disclosed)**
Polaroid OneFilm Color Print Film (ISO 200) (initial type: 1989–91) (Although the film was labeled by Polaroid as "Made in U.S.A.," it was actually manufactured in Italy by a subsidiary of the 3M Company.)	(not disclosed)
Polaroid HighDefinition 100 Color Print Film (The initial version of this film was introduced in Europe and Australia in 1989; the current version was introduced in Europe and Australia in 1990, and in the U.S. in 1992. The film is made in Japan by Konica — see Table 5.14.)	**(not disclosed)**
Polaroid HighDefinition 200 Color Print Film (The initial version of this film was introduced in Europe and Australia in 1989; the current version was introduced in Europe and Australia in 1990, and in the U.S. in 1992. The film is made in Japan by Konica — see Table 5.14.)	**(not disclosed)**
Polaroid HighDefinition 400 Color Print Film (The initial version of this film was introduced in Europe and Australia in 1989; the current version was introduced in Europe and Australia in 1990, and in the U.S. in 1992. The film is made in Japan by Konica — see Table 5.14.)	**(not disclosed)**

Process E-6 Compatible Color Transparency Films:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye or 0.10 d-min Color Imbalance
Polaroid Professional Chrome Film 64 Tungsten **Polaroid Professional Chrome Film 100 Daylight** (The 64T and 100D Process E-6 sheet films, which were introduced in 1985, are manufactured for Polaroid by Fuji Photo Film Co., Ltd. in Japan and are believed to have stability characteristics that are identical to Fujichrome transparency films of the same ISO ratings — see Table 5.11.)	**(not disclosed)**
Polaroid 35mm Presentation Chrome Film (This film is manufactured for Polaroid by the 3M Company in Italy and is believed to be essentially identical to 3M ScotchChrome 100 Film ["improved"]. Earlier versions of Polaroid Presentation Chrome Film were believed to be identical to now-discontinued 3M ScotchChrome 100.)	**(not disclosed)**
Polaroid Superchrome 100 Slide Film (Initial type made by Agfa for Polaroid and sold in Spain and Portugal.)	(not disclosed)
Polaroid HighDefinition 100 Chrome Film (introduced in Europe and Australia in 1989; film is made in Japan by Konica — see Table 5.15.)	**(not disclosed)**

Table 5.17 Predicted Dark Fading Stability of 3M Scotch Color Papers, Color Negative Films, and Slide Films (from Data Supplied by 3M Italia and Based on Arrhenius Accelerated Dark Fading Tests)

Estimated Storage Time for a 20% Loss of Least Stable Image Dye for Storage in the Dark at 75°F (24°C)

(Note: Predictions Are for Storage at 50% RH)

Boldface Type indicates products that were being marketed in the U.S., Italy, and/or other countries when this book went to press in 1992; the other products listed had been either discontinued or replaced with newer materials. These estimates are based on initial cyan, magenta, and yellow densities of 1.0 with full d-min corrected densitometry. These estimates are for dye fading only and do not take into account the gradual formation of yellowish stain. With print materials in particular, the level of stain may become objectionable before the least stable image dye has faded 20%.

All 3M Scotch color films — including all those marked "Made in USA" — are actually manufactured in Ferrania, Italy by 3M Italia S.p.A. (a subsidiary of the 3M Company, St. Paul, Minnesota).

(N) = For printing color negatives

Color Papers, Transparency Films, and Dry Silver Materials:	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
3M High Speed Color Paper Type 19 (EP-2) (N)	22 (–C)
3M Professional Color Paper Type 25 (EP-2) (N)	22 (–C)
3M Color Laser Imager Paper and Transparency Film (EP-2)	**(not disclosed)**
3M Color Laser Imager Paper and Transparency Film (RA-4)	**(not disclosed)**
3M Dry Silver Color Materials	**(not disclosed)**
Process C-41 Compatible Color Negative Films:*	
3M ScotchColor 100 Color Print Film (formerly 3M Scotch HR 100 Color Print Film) (improved-stability type: 1990—)	**(not disclosed)**
3M ScotchColor 200 Color Print Film (improved-stability type: 1990—)	**(not disclosed)**
3M ScotchColor 400 Color Print Film (improved-stability type: 1991—)	**(not disclosed)**
3M Scotch HR 100 Color Print Film (initial type)	20 (–C)
3M ScotchColor 200 Color Print Film (initial type) 3M Scotch HR 200 Color Print Film	16 (–C)
3M ScotchColor 400 Color Print Film (initial type) 3M Scotch HR 400 Color Print Film	12 (–C)
3M Scotch HR Disc Film (initial type)	**19 (–C)**

Process E-6 Compatible Color Slide Films:*	Estimated Years of Dark Storage for 20% Loss of Least Stable Dye
3M ScotchChrome 100 Film (improved type: 1988—)	**(not disclosed)**
3M Scotch 100 Color Slide Film (1987 version)	(not disclosed)
3M Scotch 100 Color Slide Film	60 (–C)
3M Scotch CRT 100 Film	(not disclosed)
3M ScotchChrome 400 Film (improved type: 1988—)	**(not disclosed)**
3M ScotchChrome 800/3200 P Film (1988—) (initially supplied for the European market; the film itself is essentially identical to 3M ScotchChrome 400)	**(not disclosed)**
3M Scotch 400 Color Slide Film (1987 version)	(not disclosed)
3M Scotch 400 Color Slide Film	47 (–C)
3M ScotchChrome 640T Film (formerly 3M Scotch 640T Color Slide Film)	**60 (–C)**
3M ScotchChrome 1000 Film (formerly 3M Scotch 1000 Color Slide Film)	**25 (–C)**

* Prior to early 1986, Scotch brand color negative and color transparency films were sold under the 3M Color Print Film and 3M ColorSlide Film names (the stability characteristics of the films remained the same when the names were changed). In late 1988 the ScotchChrome name was adopted for all new color transparency films — films that were already on the market were renamed and supplied in the new ScotchChrome style of packaging. In 1990 all 3M color negative films were given the 3M ScotchColor name and a new packaging style was adopted.

End of Chapter 5