TI2080 Revised 11-02

Environmental Effects on the Stability of Images on KODAK Thermal Print and Transparency Material

1) General Information

The image stability of all photographic materials is influenced by various factors including temperature, relative humidity, exposure to light, and other environmental effects such as biological and chemical surface contamination.

The purpose of this document is to identify and control those chemical contaminants that affect the stability of thermal images. By understanding and applying the information in this report, end users can control or eliminate the vast majority of environmental causes of image stability problems. By giving proper attention to the care and protection of thermal images, customers can obtain a high level of image permanence. It is Kodak's goal to maintain our present position as the recognized leader in the permanence of thermal dye sublimation images.

This document applies to KODAK EKTATHERM, KODAK THERMACOLOR, KODAK EKTASCAN, and KODAK 3000 materials, both paper prints and transparencies.

Sources of Contamination

Skin oils, as evidenced by fingerprints and certain plastics, notably polyvinyl chloride, are the most common and well-documented sources of contamination. Polyvinyl chloride is also referred to as PVC and sometimes simply as vinyl. The effects of fingerprints vary widely due to the amount of tri- and di-glycerides, free fatty acids, wax esters, squalene, and cholesterols in the individual's skin that is transferred to the image.

PVC is sometimes used as enclosures for photographic prints and films in the form of sleeves, albums, see-through notebooks, portfolios, and presentation or display books.

In the health care industry, file folders, pockets, wallets, jackets, organizers, caddies, mounts, protectors, separators, binders, and carriers are sometimes made from PVC. It is difficult to characterize these products and generalizations are risky since materials vary with manufacturer and may change in chemical composition from lot to lot. The cause of the contamination is primarily dependent on the amount of plasticizer, usually phthalated esters, that is used in these PVC enclosures. Portfolios with concentrations of up to 18 percent by weight of 2-ethylhexylphthalate plasticizer have been documented.

Other potential sources of contamination include food oils, and fats such as butter, margarine, animal fats, cooking and salad oils, and nuts. Common organic solvents such as acetone, alcohol, gasoline, toluene, ethylene glycol and cosmetics, cleaning agents, polishes, and medicine may also contaminate thermal prints.

The Mechanism

These contaminants act as solvents and tend to dissolve and extract the image dyes. These extracted dyes are close to or on the surface of the print and are therefore susceptible to the destructive action of time, heat, and light.

How Observed

The effect of contaminants is usually observed as localized areas of lower density and discoloration. These patterns or spots often give clues to the source of contamination. Skin oils generally appear as finger or hand prints along the outside few inches of the imaged areas. Contamination from plastics may be observed in patterns resembling the wrinkles, distortions, and contact areas of the plastic. The discoloration appears brown and red in comparison to the surrounding image. This is because the image dyes are extracted and fade at different rates. Discolorations are most apparent in uniform and medium density (about 1.00) areas of the print or transparency. The loss in density and discoloration does not take place immediately. It may occur in as little as two or three days, or may take as much as three to six weeks. Elevated temperatures or exposure to light accelerates the effect. Contaminated prints can also produce a phenomenon called retransfer in which the extracted image dyes being close to or on the surface of the print can transfer to other surfaces in contact with the image.

The transferred dye may be observed as dye (usually cyan) on borders or backs of adjacent prints, on certain plastics, or on fingers of people handling prints. In extreme environments, such as plasticized PVC notebooks or portfolios, large amounts of dye can retransfer to the PVC. Also in these extreme environments, the images made on the various printers can move through the paper and appear as crude images on the back of the prints.

Other Potential Sources of Contamination
A variety of materials are available for coating, mounting, displaying, and retouching conventional photographic prints and films. There is little specific information on the compatibility of most of these materials with thermal prints and transparencies, but it is prudent to consider them potential sources of contamination unless tested and proven otherwise. The list includes:

film cleaners	tints	antistatic agents
protectors	colorants	dyes
texturizers	etches	pastes
preservatives	reducers	masking materials
lubricants	cements	marking pens
waxes	opaques	inks
adhesives	conditioners	mounting tissues
labels	tape	pre-paste boards

These materials may be available as solutions, sprays, coatings, or pressure-sensitive materials.

Kodak's thermal prints have been used extensively for laminated photo identification applications. Laminates generally consist of a polyester-type support with a hot melting, adhesive coating. Most commercially available laminates are not compatible with thermal images. This incompatibility may be observed as stains, image fade, color shifts, or a loss in image sharpness (smear). Some laminates, such as KODAPAK ID Laminate which is available from Kodak's Edicon Systems Division, are compatible with thermal prints . These laminates provide excellent protection against contamination, wear, and moisture and also contain ultraviolet absorbers that offer added protection against light fade. Laminating is an excellent choice for prints that are to be displayed or extensively handled.

Recommended Preventative Actions
1. General

   For maximum permanence all photographic and thermal prints and transparencies should be stored in a cool, dry environment free of chemical contamination. Generally, the lower the temperature the better. Temperatures exceeding 75 F (25 C) for extended periods should be avoided.

   Relative humidities between 30 and 50 percent are ideal. Avoid exposure to high intensity light sources, particularly those rich in ultraviolet radiation such as fluorescent lamps and direct sunlight.

2. Filing and Enclosures

   Most clean, uncoated, good quality papers, folders, and cardboard are satisfactory filing materials. Uncoated polyethylene teraphthalate (PET) is the preferred sleeving material. Albums, sleeves, notebooks, folders, etc., made from polypropylene or polyethylene are generally satisfactory. PVC or any plastic which contains plasticizer, should be avoided. PVC and plasticizer usually can be identified by a distinctive "plastic" odor.

3. Handling

   The image side of the paper and transparency material must not be touched or handled prior to printing. The printer's User's Manual and the paper or transparency packaging describes how to load print paper or transparency material without fingerprinting by retaining the stiffener boards.

   Excessive handling of prints or transparencies should be avoided after printing. Hands should be clean and free of food, oils, and grease. Handling prints by edges or with clean gloves is advised.

4. Customer Evaluation

   Customers are encouraged to conduct their own evaluation to determine compatibility of thermal images in their own environment. This is particularly important if special handling, storage, or enclosures are involved. A suggested test procedure:

Image:	A uniform, medium density (about 1.00) neutral image is the most critical.
Imprint or contact:	Questionable materials or potential contaminants are imprinted on, or contacted and stored with, the above images. Prints or areas of prints that have not been imprinted or contacted should be included for comparison.
Storage and evaluation:	The effects of contamination usually occur in the first six weeks. Elevated temperatures or exposure to light can be used to accelerate and predict longer range image permanence, for example, one week at 50°C (122°F) or four weeks exposure to 5.4 Kilolux fluorescent illumination. 5.4 Kilolux is approximately equal to ten times the illumination of well-lit office areas.

5. Printing and Finishing

   The XL, PCD, and EKTASCAN Printers contain a finishing unit, which is a thermally controlled system of rollers that uses heat and pressure to finish" or "fix" the prints or transparencies by driving the dye into the image receiving layers. Finishing is important to obtain maximum image permanence and to minimize the effect of any surface contamination. Incomplete finishing may occur if the finisher has not yet come to a steady-state temperature. To ensure a steady-state temperature, allow the printer to warm-up a total of 60 minutes after turning it on, or an additional 45 minutes after the "ready" prompt appears on the display.

2) Summary

Kodak thermal dye images are capable of a high level of image permanence. This document has attempted to identify, understand, and control sources of chemical and environmental contamination that could detract from that permanence. Only the end user or customer can determine what, if any, precautions or controls are necessary to assure that the image permanence required for his or her specific application is met.

Note: The contents of this publication are subject to change without notice.

Kodak Professional Division
EASTMAN KODAK COMPANY - Rochester, NY 14650

End of Data Sheet