PRESERVING PHOTOGRAPHS

The following text is adapted from selected leaflet webpages on the Northeast Document Conservation Center website: http://www.nedcc.org/resources/leaflets.list.php.

Guide to Film Base Photographic Materials: Identification, Care, and Duplication

Introduction & Identification

There are three broad types of film base photographic materials: cellulose nitrate, cellulose acetates, and polyester. These materials have been used as a support for negatives, positive transparencies, motion pictures, microfilm, and other photographic products. The first two, i.e., cellulose nitrate and cellulose acetates, are unstable. Due to their degradation characteristics, they can severely harm and even destroy photographic collections, in addition to posing serious health and safety hazards.

Nitrate Film Base

In 1889 Eastman Kodak began selling the first photographic negatives on cellulose nitrate flexible film support, providing the start of a photographic revolution. The increased convenience of flexible films (versus glass negatives) allowed professional photographers to shoot more pictures under a greater variety of conditions. This innovation also created a new amateur market which quickly became the economic foundation of the photo industry. Nitrate film remained in production in various formats, until the early 1950's.

As a photographic support it had some serious disadvantages. Nitrate film is highly flammable and releases hazardous gases when it deteriorates. Large quantities of nitrate film has caused several disastrous fires. Due to the instability of cellulose nitrate, much of our photographic legacy from this period is disappearing.

A photographic collection that contains any flexible, transparent film negatives from the time period of 1890-1950 has nitrate film in it. *These negatives need special attention and should immediately be separated from other negatives.* Deteriorating nitrate negatives are easy to identify, but nitrate negatives in good condition are almost indistinguishable from other types of transparent films. There are four ways to identify nitrate negatives.

1. Edge printing

Many manufacturers stamped professional sheet films with an identification along one border. Identifiers include the manufacturer and the type of film: "nitrate" or "safety." Unfortunately edge printing was not done by all manufacturers, and was neither done on early nitrate negatives nor on some roll film formats. Amateur roll films were not marked but can be identified by their tendency to curl into very tight scrolls. Later roll films were coated on both sides to prevent such curling. A "V" notch code can also identify Kodak sheet film (prior to 1949) as nitrate.

2. Dating Information

The dates Eastman Kodak stopped the manufacture of nitrate film follow. If a negative can be accurately dated, either by subject or by the photographer's notes, it is possible to determine if it is nitrate film.

Type of Film	Last Year of Nitrate Manufacture
X-ray films	1933
Roll films in 35mm	1938
Portrait and Commercial sheet films	1939
Aerial films	1942
Film Packs	1949
Roll films in sizes 616, 620, etc.	1950
Professional 35mm Motion Picture films	1951

3. Nitrate film base deterioration

A third means of film base identification is based on the observations of deterioration. The decomposition of cellulose nitrate releases gases: nitric oxide, nitrous oxide, and nitrous dioxide. In the presence of atmospheric moisture, these gases combine with the water to form nitric acid. The formation of nitric acid can further degrade the cellulose nitrate film, destroy enclosures in which the negatives are stored, and also damage materials in close proximity to the collection.

Isolate and properly store cellulose nitrate materials because of their extreme flammability, especially when in a deteriorated condition. They should be stored in a controlled environment of relatively low humidity or, ideally in cold storage.

Cellulose nitrate decomposition can be very rapid. Deterioration is generally categorized in six progressive stages:

Level 1	No deterioration.
Level 2	The negatives begin to yellow and mirror.
Level 3	The film becomes sticky and emits a strong noxious odor (nitric acid).
Level 4	The film can become an amber color and the image begins to fade.
Level 5	The film is soft and can weld to adjacent negatives, enclosures and photographs.
Level 6	The film can degenerate into a brownish acid powder.

Most negatives will retain legible photographic detail into the third stage of decomposition. These negatives may become brittle but with careful handling can be duplicated. Negatives in the fourth, fifth, and sixth stages of decomposition generally have no legible image and should be either placed in cold storage or duplicated.

4. Testing

Tests provide a more exact, but not completely definitive, way of identification. There are four tests, three of which are destructive; they require that a sample be taken from the film base material in question. Any destructive tests should be performed only after all other identification procedures have been conducted and identification remains uncertain.

a) Polarization Test

When viewed between cross-polarized filters, polyester and other highly birefringent materials exhibit red and green interference colors like those seen on soap bubbles. Cellulose nitrates and the cellulose acetates do not show these interference colors. The Polarization Test can be performed with the simple viewer described below.

To use the viewer unfold the viewer and place a corner of the material in question over one polarizing filter. Close the viewer and hold the viewer up to a light source. Tilt viewer back-and-forth and side-to-side, red and green interference colors will be most apparent in clear areas. If a material is badly deteriorated, examine it on a light table with one polarizing filter underneath it and one on top of it.

Instructions for Making a Viewer

1. Tape together two pieces of mat board along their long edge.
2. At the left corner of each mat board split an area slightly larger than the polarizing filter.
3. Cut a hole in each split area smaller than the polarizing filter.
4. Slip polarizing filters into each split board. Be sure to place the filters so that they are almost at cross polars to one another. This will be at the point at which they block the most light passing through them.
5. Apply double-sided tape to reattach the split boards and to hold the filters in place. (Polarizing filters are available at toy stores in many children's science kits.)

b) Diphenylamine Test

Handle this solution with caution; it contains 90% sulfuric acid! A solution of diphenylamine and sulfuric acid can be used to identify cellulose nitrate. In this solution cellulose nitrate turns a deep blue color. Cellulose acetate and polyester do not produce this color. However, cellulose nitrate is used in very small amounts in the manufacture of cellulose acetate and polyester products. This “subbing layer” does not appear to effect either the longevity or the safety of these materials, but may cause a very faint blue tinge to be seen in the support of the cellulose acetates and polyester.

Place sample on a microscope slide and apply a drop of the prepared solution. After one minute, a cellulose nitrate sample will turn completely blue while the cellulose acetates and polyester will not. In some cases, a large cellulose nitrate sample may exhaust the solution and no blue color will form. Therefore, to confirm a negative test, apply two more drops and wait another minute to confirm that the sample is not cellulose nitrate.

c) Burn Test

Do not perform near your collection! Cellulose nitrate is extremely difficult to extinguish. The burn test uses the flammable nature of cellulose nitrate for identification since both the cellulose acetates and polyester are much less flammable. Cellulose nitrate burns quickly and has a characteristic yellow flame. Having known materials for comparison is particularly important for this test. Hold sample vertically with metal tongs. Be sure to ignite the strip from the top, only cellulose nitrate will burn downwards. For safety, have a large container of water nearby.

d) Float Test

Trichloroethylene is toxic and a carcinogen! Conduct this test in a well-ventilated area, wear rubber gloves, and use with extreme caution. The float test may be used to identify film base types due to their differing densities. Cellulose nitrate being the most dense will sink, while cellulose acetate will rise to the top. Polyester should remain in the center of the solution. Results from this test may be difficult to interpret because deteriorated acetate film may sink to the bottom like nitrate film. Another complicating factor is that the specific gravities for cellulose nitrate and the cellulose acetates fall within a fairly broad range which may cause materials to behave differently. As with the other tests, having a known sample for comparison can be extremely helpful. Place sample in a test tube of trichloroethylene. Shake test tube so sample is completely immersed. Observe location of sample in the liquid.

Acetate Film Base

Beginning in the mid 1920's, nitrate film was slowly replaced with cellulose acetate film base. It became known as "Safety" film. However, the cellulose acetates used have stability problems. Once deterioration has begun the degradation products induce further deterioration. It affects the plastic support of acetate film, causing it to become acidic, to shrink, and to give off an odor of acetic acid (vinegar).

To determine the amount of acid vapor present, there are "A-D Strips" (acid-detecting strips) from the Image Permanence Institute at the Rochester Institute of Technology in Rochester, NY. These are acid-base indicator papers which turn from blue to green to yellow in the presence of acid, and measure the extent of the acetate base support deterioration.

As with nitrate negatives, deteriorated acetate negatives are easy to identify, but in good condition are almost undistinguishable from other types of plastic films. There are also four ways to identify acetate film base negatives.

1. Edge printing

Some cellulose acetate film base materials have the word "Safety" contained in the border. Those manufactured prior to 1955 are definitely acetate. Edge printing may also include the name of the manufacturer, manufacturing code data, and notch codes.

2. Dating information

	Sheet Film	Roll Film
Cellulose diacetate	1925-1950	1920-1935
Celluluse acetate propionate	1930-1945	1920-1945
Cellulose acetate butynate	1935-present	1935-present
Cellulose triacetate	1945-present	1945-present

3. Acetate film base deterioration

When acetate base film is stored in a poor environment at high heat and humidity, or exposed to acidic vapors from nearby degrading film, cellulose acetate undergoes chemical reactions within the plastic support to form acetic acid. It causes the support to become acidic, brittle, and shrink. This in turn spreads into the gelatin emulsion or into the air creating a harsh, acidic odor. It is a slow form of chemical deterioration known as "Vinegar Syndrome." It places acetate film at risk, and then deterioration may place otherwise stable photographic materials at risk as well.

Deterioration is generally catalogued in six progressive stages:

Level 1	No deterioration.
Level 2	The negatives begin to curl and they can turn red or blue.
Level 3	The onset of acetic acid (vinegar smell); also shrinkage and brittleness.
Level 4	The warping can begin.
Level 5	The formation of bubbles and crystals in the film.
Level 6	The formation of channeling in the film.

Care of Negatives

Environment

Ideally, negatives should be stored in a freezer. At freezing temperatures the natural decomposition of cellulose nitrate and acetate is slowed down. A fairly inexpensive cold storage unit is a large commercial freezer which should defrost automatically.

Storage materials designed to preserve photographic materials are archival boxes placed in polypropylene bags and then sealed with humidity control cards. This allows the stored items to warm at room temperature safely (8–12 hours should be sufficient) and can be easily accessed.

Storage

Cellulose nitrate negatives should be stored separately from other negatives in a collection. They present a great potential hazard to other materials because of their flammability and because of the strong acid formed from gases that the negatives release.

Three layers of protection are recommended for the storage of film base photographic materials. Negatives should be placed in sleeves, sleeves in a box or drawer, and these boxes or drawers on shelves or in a cabinet. Motion picture film and microfilm should be stored in unsealed containers in cabinets or on shelves.

Negatives should be stored in individual, seamless, high alpha cellulose content paper enclosures to allow for the dissipation of harmful gases. Acid-free paper also resists deterioration caused by the formation of acids. Alternatively, negatives should be stored in polyester (mylar) or polyethylene enclosures. Enclosures that have been used to store negatives must never be reused. They will retain acids, and anything placed in them will be damaged.

Duplication

When?

Duplication is an ongoing process. Negative collections should be inspected regularly for signs of deterioration. Any negatives showing signs of deterioration should be duplicated as soon as possible. Nitrate and safety negatives in good condition that are printed or handled often should also be duplicated. The duplicate negative can then be used while the original remains in cold storage. This minimizes the potential of damage to, or loss of, the original negative.

Tone Reproduction and Image Permanence

There are two areas of concerning the duplication of film base materials. The first is tone reproduction: how accurately does the duplicate negative resemble the original? Every duplication system should be designed for good tone reproduction. The duplicate negative should resemble the original in all aspects, having the same density range, overall density, and amount of detail.

The second is image permanence: the duplicate must be made on the most stable modern films and processed according to the highest archival standards using recommended techniques. The permanence of a photographic image is affected by three things: the stability of the photographic material, how it is processed, and how it is stored. Duplicate negatives should be made on archivally processed modern polyester based films, which should be archivally processed.

Photograph Duplication Options

1. The simplest way to duplicate negatives is to make a print and then use a camera system to create a copy negative of the print. This is a common procedure for prints in a collection for which there are no original negatives. This procedure can be done in even the simplest darkroom. The prints should all be made on fiber based photographic paper for maximum permanence. New prints can be copied using a large format camera, 4" x 5" format or larger. This option is relatively cheap and convenient. The disadvantage of this system is loss of detail in both the print and the copy negative. A print always has detail loss and a compressed tonal range compared to the original negative.
2. The Interpositive/Duplicate Negative Process. The most versatile duplication process produces a film interpositive and duplicate negative. The original negative is contact printed onto a sheet of film and processed. This yields a positive image on film, an interpositive. The interpositive is contact printed to produce a duplicate negative. This process can produce the most accurate duplicate negatives modern films are capable of producing. However, this method results in two copies for relatively little additional cost and additional storage requirements.
3. Continuous Tone Microfilm. The roll microfilm provides easy access to entire photographic collections. This type of microfilm supports the greater dynamic range [shades of gray] typical of photographs while line detail remains excellent. The advantages of the roll film format are that it provides ease of access to the collection at lower cost. and microfilm has a life expectancy of 500 years. The disadvantage of this format is that it does not capture the level of detail that a larger format is capable of capturing.
4. Digital Imaging System. There are a wide array of digital systems available for capturing and storing photographic images. The access capabilities of these systems are impressive, however, the long-term storage of the images is problematic. Scanning the photographic materials is one approach to access, but it is very expensive, requires a lot of expertise (or dependence on a company with that expertise), and data will have to be migrated over time as the hardware and software become obsolete. Therefore they may not be an appropriate preservation alternative for your collection.

Types of Photographic Prints

Definitions

POP (printing-out paper): A photographic paper which forms a visible image directly from the reaction of light on light-sensitive materials. POP prints are warm in tone, tending towards a brown, purple, or reddish color. They are almost always made in contact with a negative. Printing-out paper is no longer commonly available.

DOP (developing-out paper): A photographic paper which forms a visible image through the use of a chemical developer to reveal the latent image made by exposure to light. DOP prints are cool in color – blue, neutral, or black – unless they have been toned. They may be either contact-printed or enlarged from a negative.

Coated paper: A support which has an emulsion layer on its surface consisting of either albumen, gelatin, or collodion. This layer holds the light-sensitive photographic salts.

Uncoated paper: A paper support without any emulsion layer. The image often appears to be within the paper.

Distinguishing Characteristics

The following are the most important features used to identify a type of photograph:

1. Positive or negative
2. Nature of support material
3. Texture, surface quality
4. Color, tone
5. Characteristics of deterioration

Care of Photographs

Many different procedures to care for photographs have developed over time. While each procedure has its own unique deterioration characteristics and specific storage and exhibition needs, there are common factors affecting the permanence of all photographs. By controlling these factors, the deterioration of a photograph can be slowed, and its longevity greatly enhanced.

Control Air Pollution and Dirt

Pollutants and particulate matter can damage photographs, causing fading or abrasion; controlling air quality is difficult. Ideally, air entering a storage or exhibition area should be filtered and purified. Dust should be kept to a minimum. Gaseous pollution can be removed by chemical filters or wet scrubbers. Particulates can be mechanically filtered. Good air circulation is also necessary. Make sure air intake vents are not located near loading docks where trucks idle. Keep exterior windows closed when possible. Also, minimize interior sources of harmful gases, including photocopying machines, many construction materials, paint fumes, cardboard, carpets, and janitorial supplies. Metal cabinets, such as powder-coated steel cabinets, are preferable to wood as wood often generates harmful peroxides. Finally, keep photographs in archival-quality enclosures.

Enclosures keep dirt off objects and may help decrease the effects of pollutants. Enclosures containing activated charcoals and molecular traps have recently become available and appear to be effective in this regard.

Control Light Levels

Light causes photographs to fade and become brittle and yellow. Light damage is cumulative and usually irreversible. Direct sunlight is the most harmful light source; incandescent (tungsten) lighting is generally preferred to fluorescent. However, all forms of light are damaging and should be moderated.

Do not place valuable photographs on permanent display: use copies whenever possible and keep light levels as low as possible. UV-absorbing sleeves can be used to filter out damaging rays from fluorescent tubes and UV- absorbing sheets can be placed over windows or in frames. Low UV-emitting bulbs are now available. Some types of photographs are much more susceptible to light damage than others. Most color photographs fade rather quickly on display, while contemporary fiber-base black and white prints are essentially stable to light.

Control Handling

Fingerprints can cause chemical damage to photographs, resulting in bleaching or silver mirroring. Careless handling can cause physical damage such as abrasion, tears, or breakage. Use clean gloves or clean, dry hands whenever photographs are handled. Proper enclosures (sleeves, albums) provide protection from fingerprints and physical support to protect against abrasion or breakage.

If photographs must be labeled, labeling should occur on the reverse along the edge. In most cases ordinary lead pencils are recommended. Where lead pencils do not work (such as with resin-coated [RC] prints) black India ink is recommended. Berol Prismacolor non-photo blue 919, Berol China Marker brite blue 167T, or PITT (Faber Castell) Graphite Pure 2900B will write on RC paper.

Control Storage Systems

Proper storage materials are essential for the long-term stability of photographs and negatives. They provide much needed physical support and protection for fragile objects and at the same time act as a barrier between the photograph and a potentially unstable environment. It is of utmost importance that storage materials be unreactive to the photographic material. Much damage has been done in the past through the use of reactive materials such as acidic groundwood paper sleeves, rubber bands, paper clips, pressure-sensitive tapes, and staining adhesives such as rubber cement or animal glue.

When storing photographs it is best for each object to have its own enclosure. This reduces damage to the photograph by providing it with physical protection, support, and isolation from any damaging components of other photographs. Prints and negatives should not be in contact with each other in the same enclosure. Acceptable enclosures may be made of either paper or plastic.

Paper enclosures:

- are opaque, providing protection from light but results in increased handling for viewing.
- are porous, protecting the object from the accumulation of moisture and detrimental gases.
- act as a buffer against changes in humidity.
- are available in buffered and non-buffered stock.
- may contain activated charcoal and zeolites. These papers, such as MicroChamber, appear to moderate the deteriorating effect of pollutant gases.
- should not be made of kraft or glassine paper.

Plastic enclosures:

- are transparent. Photographs can be viewed without removal from the enclosure, thus reducing handling.
- can trap moisture and cause ferrotyping (sticking, with a resultant glossy area).
- should be made of uncoated polyester, polypropylene, or polyethylene.
- should not be made from polyvinylchloride (PVC).
- should not be used to store nitrate or older safety film negatives as this may hasten their deterioration.

Avoid using adhesives. Adhesives that are particularly damaging include rubber cement and the self-stick "magnetic" pages of photograph albums. Also, avoid pressure-sensitive tapes and damaging fasteners such as paper clips or rubber bands. Because adhesives can be problematic, photographs that are stored in paper envelopes should be positioned with their emulsion away from the seam. Also seams should be on the sides of the enclosure, not through the center.

Once materials have been properly housed in window mats, folders, sleeves, or envelopes, they should be stored in cabinets or boxes of archival quality. Horizontal storage is preferable for many photographic prints and oversize photographs. It provides overall support to the images and prevents bending. Vertical storage is often preferred for negative collections. Vertical storage is often more efficient and may make access to a collection easier. Glass plate negatives require vertical storage in order to prevent breakage. However, very large plates may be supported horizontally. When using vertical storage, protect materials by placing them in acid-free folders. These folders should then be stored in either hanging files or document storage boxes. Boxes should be housed on metal shelves or in metal cabinets.

Where possible, materials of similar size should be stored together. Mixing of sizes can cause abrasion or breakage. Regardless of the size of the object, all enclosures within a box should be the same size, should be larger than the materials stored in them, and should fit the box or drawer. Boxes and files should not be overcrowded.

Creating Long-Lasting Inkjet Prints

Introduction

Currently, there are no standards for longevity regarding digital images and color prints made from digital files are not considered preservation quality. Still, there are ways of creating long-lasting prints by understanding the materials employed and controlling the conditions under which the prints are stored. The three most important factors that affect the life of a digital print are the quality of materials used such as the colorant (dye vs. pigment) and paper; the combination of materials used; and afterwards, the storage and display of the prints.

Printing Technologies

Digital artists can use many output devices to create their work. The most common ones include the digital photo process, dye sublimation, electrography, and the inkjet, which has become popular since 1998.

The digital photo processor (examples include the Fuji Pictrography and Kodak Pegasus) is a high-end, large-format device used in many photo labs to print snapshots. The process involves exposing a sheet of photosensitive “donor” paper to laser diodes. Small amounts of water and heat are applied to create the dye image on the donor paper, which is then transferred to the “receiving” paper with a combination of heat and pressure. The receiving paper with its transferred dyes is peeled off and separated from the donor paper.

Dye sublimation, used by the Kodak 8500 dye-sub printer, works with a single-color ribbon containing dye heated by a special head that runs the width of the paper. When the head heats up, it vaporizes (sublimates) the dye in that location. The dye, now in gaseous form, is absorbed into the paper. Since the paper receives the dye layers separately, the print can result in a smooth, seamless image.

Electrography includes laser prints and photocopies. In this process, the toner is transferred to an uncoated paper base then fused into place. The images composed of pigment particles are generally stable but are not often used for photo-quality printing.

Of the four processes mentioned, inkjet is the most widely used printing technology for digital artists. There are two types of technologies for inkjet printers: continuous flow and drop-on-demand or impulse jet. Continuous-flow inkjet printers use an electrostatic charge to push ink out of the printhead reservoir. As the ink droplets are released, charged droplets are deflected and recycled while the uncharged particles spray a continuous stream of microscopic ink droplets onto a flat substrate. The IRIS printer is an example of the continuous-flow printer. The other type of printer, drop-on-demand, uses only ink droplets needed to form the image produced. As the printhead heats up, a bubble is produced and the increased pressure inside the printhead chamber forces the ink droplet out. After the bubble collapses, more ink is drawn from the reservoir. The Epson printer uses the drop-on-demand technology.

Materials

Ink

For inkjet printing, colorants come in two basic types: dye-based and pigment-based. Dyes, composed of single molecules, can be easily dissolved in water and, being transparent, can provide brilliant saturated color. They are able to refract or scatter very little light. But they fade more quickly than pigments, are very sensitive to water and humidity, and are more vulnerable to environmental gasses such as ozone.

Pigments, made up of a thousand molecules, are much larger than their dye counterparts. Thus, pigment-based inks have the advantage of being more stable, significantly more lightfast, and less affected by environmental factors. The disadvantage of these types of inks is that they do not dissolve easily in water. Their color range is smaller, producing less saturated and duller colors, and they have a greater tendency toward metamerism (shifting of colors under different light sources).

Paper

There are four broad categories of paper: bond paper, inkjet paper, fine art papers, and coated papers.

Bond paper is the plain paper used in laser printers and office copiers. This paper is made of wood pulp, which contains cellulose fibers, and lignin and is sized with rosin. The sizing and the lignin eventually destroy the image.

Inkjet paper, of slightly better quality than bond paper, has improved external sizings such as starches, polymers, and pigments. These sizes make the surface of the paper whiter and more receptive to inkjet output.

Fine art papers such as Arches, Rives, and Somerset have been used for watercolors, drawings, and traditional printmaking. The papers are made from 100% cotton rag (alpha-cellulose), and there is no rosin sizing or lignin. Sometimes an alkaline buffering agent is added such as calcium carbonate. The fine art papers are usually combined with dye-based inks and used with IRIS printers.

Coated inkjet papers have a receptor coating to aid in receiving the inks. These coatings create a higher-color range, better image quality, greater brightness, and ink stability, which make them less likely to bleed. Coatings may include materials such as silica, clay, titanium dioxide, calcium carbonate, and various polymers.

Long-Lasting Combinations

Images are expected to last 75 years or longer before showing signs of considerable fading, deterioration, or discoloration. Black-and-white silver-gelatin fiber-based papers meet the NR-NHL standards. Recently, color prints from digitized files prepared with specific papers and colorants have been included.

Some examples include the following:

- Epson's UltraChrome pigmented-based inks with Epson Premium Photo Papers; Epson Fine Art Papers, Epson Enhanced Matte Papers, and Somerset Velvet for Epson.
- Epson Picture Mate Inks with Epson Picture Mate Photo Papers.

- Hewlett-Packard (HP) Vivera dye-based ink set combined with HP Premium Plus Papers and HP Premium Photo Papers.

Storage Conditions

Controlling the relative humidity (RH) is one of the most important factors in preserving digital prints from deterioration. High relative humidity leads to fading and discoloration. RH above 60% can quickly lead to noticeable deterioration; RH should be kept at a stable point below 50%.

Control of temperature is also very important. Like RH, elevated temperatures speed up deterioration. High temperatures can cause rapid color fading, increased yellowing, especially in light or white areas and dye degradation and diffusion. A stable temperature should be maintained between 65° and 70°F, avoiding abrupt changes which cause stresses and lead to warping of the support.

Overview on Creating and Maintaining Permanence

- Select long-lasting colorants. Although pigment-based inks tend to have a smaller color range than dye-based inks, they exhibit longer lifespan characteristics. Currently, companies are improving the permanence of dye-based inks as well as the color range of pigment-based inks.
- Select archival paper such as 100% cotton rag. For coated papers, it is recommended that paper bases should be buffered, acid-, lignin- and optical brightener-free.
- Match media and paper correctly to get the optimum permanence. Advertised permanence tests are specific to a particular type of ink and dye on a specific paper/substrate. Substituting materials will not yield the same results. Third party inks, even though less expensive may not provide the same value. If print quality and durability are a concern, it is best to use the brand-name inks.
- After printing, keep prints away from light or display behind glass, which decreases airflow, fading from gasses and some UV exposure problems.
- Cold storage (near 32°F) of these materials is recommended like with other traditional color materials.
- If cold storage is not possible, store prints in a dark, dry and cool place. Keep humidity fluctuations to a minimum. The conditions should be 68°F (20°C) or lower with 30–40% RH.
- Store prints flat using archival materials. Place prints in individual enclosures. Don’t use paper clips, rubber bands or pressure-sensitive tape.
- Keep prints away from oxidizing materials such as household chemicals.