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[Home](#) » [Environmental Management](#) » [Climate Notes Newsletter](#) » [Preserving Film-Based Photographic Collections](#)

Preserving Film-Based Photographic Collections

A diagnostic tool like A-D Strips is only one part of managing the vinegar syndrome problem. The most important element in long-term preservation is maintaining the proper climate. Acetate and nitrate film will deteriorate over time, slowly or rapidly, depending on the temperature and RH of the storage environment. Acetate film will begin to seriously degrade in about 50 years at room temperature and moderate RH. Periods of higher temperature or dampness will accelerate the process; cold and dry periods will slow it down. Newly processed film stored in cool (72°F/21°C or less) or cold (50°F/or 10°C or less) at moderate RH (20% to 50%) can be expected to last for centuries. The same film stored under poor conditions may last only a few decades. Color film benefits doubly from cold storage—the film base is stabilized and the rate of color dye fade is minimized.

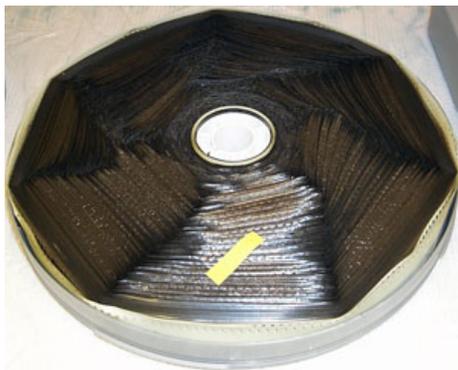
Film-based collections are threatened by several types of decay. The good news is that a proper storage environment will effectively minimize the risk of decay-related damage.

Type of Decay	Media	Recommended Environment
Silver Image Decay	Black and white film	30% to 50% RH
Color Image Decay	Color film	Low temperature, 30% to 50% RH
Nitrate Decay	Nitrate-based film	Low temperature, 30% to 50% RH
Acetate Decay	Acetate-based black and white film Acetate-based color film	Low temperature, 30% to 50% RH
Mold	All media	30% to 50% RH

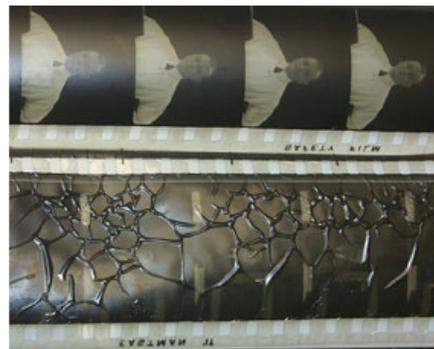
ISO Standard 18911-2000 makes the following environmental recommendations for extended storage of acetate film. There are three sets of conditions for black and white silver-gelatin film on cellulose acetate supports:

- Maximum Temperature 36°F / 2°C and Relative Humidity Range of 20% to 50%
- Maximum Temperature 41°F / 5°C and Relative Humidity Range of 20% to 40%
- Maximum Temperature 45°F / 7°C and Relative Humidity Range of 20% to 30%

Acetate film is vulnerable to chemical, mechanical, and biological decay. Chemical deterioration is the greatest threat, leading to vinegar syndrome and the possibility of silver image or color dye fading. High temperature and high relative humidity levels accelerate the rate of chemical decay. The amount of moisture in the environment is the key to limiting mechanical decay. Sustained conditions may produce irreversible deterioration or deformation by extracting moisture from the gelatin emulsion layer of the film. This is often seen as brittleness or curl. Permanent film deformation in sheet film and "spoking" in motion picture film may result. When the film base of diacetate and triacetate shrinks in relation to the gelatin emulsion, it results in the formation of deep, wavy grooves in the film base known as "channeling." Low RH can also result in emulsion flaking or delamination. Sustained high RH can cause the gelatin layer of the film to become soft and sticky, adhering to enclosures or adjacent sections of film. Mold is the primary biological threat, encouraged by high humidity. Fungus may grow on the gelatin emulsion, damaging or destroying it.



Example of “spoking” in motion picture film.



Example of “channeling” in motion picture film.

The response of acetate film to the storage environment depends on the configuration (shape and mass) of the film. Temperature equilibration occurs within a few hours in acetate film, requiring more or less time depending on the mass of film involved. Humidity equilibration times vary from a few hours to many months depending on the film configuration and the enclosure arrangements. A single sheet of film hanging on a line will equilibrate to the room RH in a matter of hours, while the same film in a file drawer may require weeks or months to fully equilibrate. Motion picture films and other roll formats have equilibration times of a month or more. Film tightly enclosed in a can may take three months or more to fully adapt to a change in room humidity.

Want it Simple?

Good film storage is **COLD**-
40° F / 4° C with
30% to 50% RH.



Even better?
FROZEN-
32° F / 0° C with
30% to 50% RH.



Enclosures have a small effect on the temperature equilibration rate of acetate film, but humidity equilibration times are profoundly affected by enclosure design, materials, and the levels of containment around the object. Storage materials should be chemically and physically stable. Use polyester, polypropylene, or polyethylene enclosures, never PVC or acetate. Papers and paperboard must be neutral-sized, lignin-free, buffered materials.

If you decide to provide cold or frozen storage for your movies and still negative collections, your options range from household-size refrigerators and freezers to prefabricated walk-in chambers or the construction of insulated rooms. For small collections, frost-free household units are suitable as long as film moisture levels are managed. Collection materials should be conditioned to moderate RH before being enclosed in a moisture-proof housing. Resealable polyethylene freezer bags and heat-sealable bags composed of layers of aluminum foil and polyethylene and polyester have been used successfully. For larger spaces, desiccant-based humidification units are recommended, allowing climate control in the entire storage area. In this case special packaging is not needed. Be aware that transfer from refrigerated spaces into warmer areas incurs the risk of condensation on the material's surface. A temperature- and RH-controlled acclimatization chamber

is one solution; another is to use an additional water-proof enclosure, such as a plastic bag, in which materials can be placed for the warming up period. Such packaging is not needed for materials already in moisture-proof housings. In both cases, an overnight or one-day warming period prior to use of the materials is recommended.

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