

Motion picture film is a delicate document. Like other documents, it is subject to steady decay and its preservation can be prolonged or adversely affected by the environment in which it is stored. But the chemical composition of film makes it particularly susceptible to the nuances of environment. To make it more complex, film is composed of layers that do not always coexist well. The emulsion layer, whether infused with silver particles (as with black and white film) or dyes (on color film), is fragile but relatively stable compared to the base layer on which it lays. The base layer, made of acetate plastic (at least prior to the wide-scale use of polyester for 16mm film in the 1990s), is especially vulnerable to extremes in temperature and relative humidity. The predominant condition that can result from storage in high humidity situations, dubbed “Vinegar Syndrome” for its distinctive odor, causes the base layer to shrink, warp and curl in ways that make the film virtually unusable as a motion document. High humidity levels can also encourage mold growth and color dye fading.

According to the Image Permanence Institute, acetate-based motion picture film has a lifespan of 40 to 50 years when stored in normal household conditions (70 degrees F and 50% RH) – that is, before it begins to exhibit signs of deterioration. It is interesting to note that a good portion of vintage films are *already* 50 years old or older! The clock is not just ticking; the alarm has sounded.

## Ideal storage environments

The Image Permanence Institute recommends the following ideal storage conditions for acetate-based film:

- For black-and-white film:
  - 36 degrees F maximum temperature for 50% maximum RH
  - 41 degrees F maximum temperature for 40% maximum RH
  - 45 degrees F maximum temperature for 30% maximum RH
  
- For color film:
  - 14 degrees F maximum temperature for 50% maximum RH
  - 27 degrees F maximum temperature for 40% maximum RH
  - 36 degrees F maximum temperature for 30% maximum RH

### **Storage environment for mixed collections**

Few archives, museums or libraries have dedicated storage for film-based materials. Practical applications of environmental control must account for other kinds of documents, artifacts and published material sharing the space. Given these realities, an ideal combination of temperature and humidity for storage of mixed cultural heritage collections is 40 degrees F and 40% relative humidity.

In general, the Image Permanence Institute contends that lowering the temperature will greatly increase the life of plastics and other organic materials. Also, neither temperature nor relative humidity should fluctuate rapidly.

### **Other storage advice**

Besides the conditions of temperature and relative humidity, there are other basic guidelines for the storage of motion picture film:

- Store films in cans made of inert plastic or acid-free boxes made for film storage. Vented cans are best. At least, replace corroded metal cans, and do not store film in plastic bags
- Films are best stored on cores rather than reels. If reels are used, make sure they are clean and show no signs of corrosion
- Stack films horizontally, no more than eight high
- Store away from sources of heat, sunlight, water, exhaust and fumes
- Provide good air flow and air exchange, so that off-gasses can dissipate
- Label enclosures and film leaders to identify films

### **Separating affected film from the rest of the collection**

Acetate-based films that suffer from Vinegar Syndrome emit acidic gasses that can be absorbed by other films stored in close proximity. It is therefore often suggested that such films be segregated from others. However, this is often not practical in mixed-storage situations. Temperature and relative humidity are much more important factors in a film's deterioration. Also, good air circulation and exchange can go a long way to alleviate the effects of off-gassing.

### **Freezing film**

The lifespan of films that exhibit advanced signs of Vinegar Syndrome or color fading can be greatly increased by storing them in frozen conditions. Frozen storage does not "cure" deterioration, but arrests it. Standard home-use freezers can be used for small collections, as long as they are "frost-free." Humidity is further controlled by suitably preparing and packing the film. For detailed instructions on freezing film, see [www.filmforever.org](http://www.filmforever.org), Section 8.2.