

## M E M O R A N D U M

**DATE:** January 16, 1996

**TO:** WEED Staff

**FROM:** Robert Isner, ext. 2172 *RI*

**RE:** FYI Old Photograph (& motion picture) Film

=====  
 Earlier this month Gloria Rabain received a call from someone asking how old 35mm developed film (the negative) is regulated. At issue is approximately 500-600 rolls.

I contacted a representative from Kodak Environmental Services (Debbie Stein, 716-477-3194) who passed along the following general information:

- If Kodak film consult with Kodak for specific information.
- **If the film is older than 40 or 50 years, be very careful.** The base material used was likely cellulose nitrate which over time may decompose into an unstable and readily ignitable form. The film in some cases may also become somewhat explosive characteristics. Kodak has identified old film as D001, D003 or D011 RCRA wastes.
- If the film is not more than 40 or 50 years old, and is black and white, the film is probably an acetate or PET base. Kodak will send a letter indicating current Kodak film and paper are below RCRA TCLP limits. Kodak recommends sending developed films for reclaim of the silver and base media materials, although typically accumulation of about 1,000 pounds may be necessary before this is feasible. Kodak can help identify recycling points.
- Color films are considerably more variable and thus the manufacturer(s) should be consulted.

If you have any questions or need more detail, call me at x2172 or call Kodak Environmental Service directly at 716-477-3194. If you have additional information on this subject please let me know and I will make a note on this memo accordingly.

g:/memos95sstaff



January 9, 1996

Mr. Robert Isner  
Connecticut DEP/Bureau Of Waste Mgmt  
79 Elm St  
Hartford, CT 06106

RECEIVED

JAN 16 1996

DEP-WASTE MANAGEMENT BUREAU  
WASTE ENG. & ENF. DIVISION  
DIRECTOR'S OFFICE

SUBJECT: EPA Toxicity Issues Concerning Kodak Photographic Films  
and Papers

Dear Mr. Robert Isner:

This letter is in response to your concerns about the Toxicity Characteristic of Kodak films and papers. Representative photographic films and papers, both processed and unprocessed, were tested using the TCLP (Toxicity Characteristic Leaching Procedure) test. These films and papers did not exhibit the Toxicity Characteristic (TC). In addition, these photographic films and papers do not exhibit the other hazardous characteristics (i.e., ignitability, corrosivity, or reactivity). Therefore, Kodak photographic films and papers are not considered hazardous wastes under Federal regulations.

This conclusion, however, does not preempt state or local laws and programs. Contact the municipal or industrial disposal facility in your area to verify that photographic films and papers may be disposed of safely.

If you have additional questions or require further assistance, please call (716) 477-3194.

Thank you for using Kodak products.

Kodak Environmental Services  
Eastman Kodak Company  
Rochester, NY 14652-6255

VW/0040A/4-7-93



# Environment

INFORMATION FROM KODAK

## Safe Handling, Storage, and Destruction of Nitrate-Based Motion Picture Films

Photographic films on cellulose nitrate base (nitrocellulose) were first introduced by Eastman Kodak Company in 1889. This film base had excellent physical properties, but suffered from poor chemical stability and high flammability. In 1948, cellulose triacetate support was introduced; it met the performance requirements of motion picture films and provided added safety. After 1951, no cellulose nitrate motion picture film was manufactured by Kodak.

Actual use of cellulose nitrate films in theaters has virtually ceased. However, large quantities of cellulose nitrate film for archival or other purposes still exist in storage. These films are typically kept in vaults and removed for limited projection, reprinting and restoration on safety films, or destruction.

This publication will help you recognize and avoid the hazards associated with cellulose nitrate motion picture films. To safely handle, store, transport, and destroy these films, you must understand these hazards. The information in this publication is based on requirements in the United States; requirements may differ in other countries.

The storage and handling requirements presented are primarily from the National Fire Protection Association (NFPA), *Standard for the Storage and Handling of Cellulose Nitrate Motion Picture Film*, 1994 Edition (NFPA 40). The NFPA standards are not laws; however, states or local authorities, such as a government agency, local fire department, or a building/electrical inspector may require compliance with the NFPA standard.

### Identification

Depending on the age of cellulose nitrate films, the edge of the film may be marked as nitrate film ("NITRATE FILM" or "N").

The words "SAFETY FILM" may appear in the non-image area of a motion picture film. This usually indicates that the base is made of a material, such as cellulose triacetate, that passes the ISO 435 test for burning and ignition. However, early motion picture films marked "SAFETY FILM" may have been *printed* on cellulose nitrate film, which would also carry the "SAFETY FILM" markings from print through. If a film cannot be clearly identified by markings, testing may be required to determine the composition of the film base.

H-182 \$1.00

This publication  
will help you  
understand the  
requirements to  
safely handle, store,  
transport, and  
destroy cellulose  
nitrate-based films.

RECEIVED

JUN 11 6 1996

DEP-WASTE MANAGEMENT BUREAU  
WASTE ENG. & ENF. DIVISION  
DIRECTOR'S OFFICE



There are several methods to identify a film base.

You can prepare and analyze a sample of a film base by infrared absorption through an analytical laboratory using the procedure outlined in ISO 10682. Another test to distinguish nitrate film from safety film is to punch or cut a ¼-inch-diameter sample from the film and place it in a test tube or small bottle containing trichlorethylene. You will need to shake the liquid to ensure that the sample is completely immersed. Cellulose nitrate films will sink in the liquid and safety films will float to the surface. Cellulose nitrate films that have started to deteriorate may change density and may not sink in the trichlorethylene. Always perform this test in a well-ventilated area to minimize exposure to trichlorethylene. Dispose of used trichlorethylene as a hazardous waste.

### Deterioration

In addition to the inherent hazards associated with the flammability of cellulose nitrate film, decomposition of the film also can present safety concerns during its storage, handling, transportation, and destruction. The deterioration of cellulose nitrate films can be divided into five distinct stages:

Stage 1	Film has an amber discoloration with fading of the image. Faint noxious odor. Rust ring may form on inside of metal film cans.
Stage 2	Emulsion becomes adhesive and the film tends to stick together during unrolling. Faint noxious odor.
Stage 3	Portions of the film are soft, contain gas bubbles, and emit a noxious odor.
Stage 4	Entire film is soft and welded into a single mass, the surface may be covered with viscous froth, and a strong noxious odor is given off.
Stage 5	Film mass degenerates partially or entirely into a shock-sensitive brownish acrid powder.

Deteriorated films in the first two stages are photographically reproducible. Unless you have expertise in determining the characteristics of nitrate films in various stages of decomposition, do not unroll the films.

For help determining the historical value of any material on nitrate base, contact a local historical film association, or one of the following:

Library of Congress  
Motion Picture, Broadcasting and  
Recorded Sound Division  
Washington, D.C. 20540-4800  
Phone (202) 707-5840  
Fax (202) 707-2371

National Archives and Records  
Administration at College Park  
8601 Adelphi Road  
College Park, MD 20740  
Phone (301) 713-6700  
Fax (301) 713-2371

International Museum  
of Photography at  
George Eastman House  
900 East Avenue  
Rochester, NY 14607  
Phone (716) 271-3361

Federation Internationale des  
Archives du Film (FIAF)  
FIAF Secretariat  
rue Franz Merjay 190  
1180 Bruxelles/Brussels  
Phone 32-2-343-06-91  
Fax 32-2-343-76-22

### SAFE HANDLING

As cellulose nitrate film decomposes, it can release nitric oxide, nitrogen dioxide, and other gases. These vapors will accelerate the decomposition of the remaining film base. Depending on the airborne concentration, vapors from decomposing film may be irritating to your eyes, nose, and throat. Providing adequate ventilation reduces the airborne concentration of the vapors and ensures that exposure limits established by the Occupational Safety and Health Administration (OSHA) or the American Conference of Government Industrial Hygienists (ACGIH) will not be exceeded.

To avoid contact with your skin and eyes, and to reduce the possibility of injury, *always* wear impervious gloves, such as rubber or neoprene, and eye protection when handling decomposing cellulose nitrate film.

### PRESERVATION AND STORAGE

Because cellulose nitrate films are flammable and there are decomposition concerns, you need to store and manage them in a safe manner that limits decomposition. You can preserve or duplicate cellulose nitrate films until the third stage of decomposition. Cellulose nitrate films that have reached the third stage of decomposition, or that have no historical value, should be destroyed at an authorized facility.



## Storage

Choosing a storage facility for cellulose nitrate films depends on the amount of film to be stored.

For *short-term storage*, you can use approved film cabinets for storing up to 750 pounds of film (equal to 150 1000-foot rolls). Use vaults for *longer-term storage* of amounts up to 750 pounds. Always store amounts *over 750 pounds* in vaults. Be sure to segregate cellulose nitrate films from other film storage areas.

For extended-term storage (for preservation of material having permanent value), store in archival cabinets or vaults that contain individual compartments and allow for decomposition gas venting.

Do not exceed 70°F inside the storage vault, and maintain the relative humidity below 50 percent. For long-term storage requirements, store the film at 35°F at 20- to 30-percent relative humidity.

Refer to the design specifications for film cabinets and vaults, including materials of construction, maximum capacity, venting, and sprinkler requirements found in NFPA 40, Chapter 4.

In addition to cool and dry storage, Molecular Sieves are recommended for storage of all cellulose nitrate films. You can promote extended keeping and preservation of cellulose nitrate films with the placement of Molecular Sieves inside the film storage container. These sieves scavenge and catalytically decompose the gases that are generated during the storage of cellulose nitrate films and retard the degradation reactions. Molecular Sieves are available from FPC, 6677 Santa Monica Boulevard, Los Angeles, California 90038, (800) 814-1333 or (213) 468-1574.

Exposure to temperatures in excess of 185°F accelerates decomposition of these films. While they deteriorate, nitrate-based films can develop pressure and heat in the film can, especially when the can is taped closed. Contained gases and heat can lead to spontaneous combustion. Therefore, it is recommended that you store cellulose nitrate films in painted or tin-plated metal cans with loose lids. Do not tape the lids or use tight-fitting lids unless you are using Molecular Sieves.

Decomposition gases (powerful oxidizing agents) can also react with nearby acetate- and polyester-base films, so you will need to store cellulose nitrate films in a separate area. The decomposition gases can also promote decomposition of nearby cellulose nitrate films. If your cellulose nitrate films need to be stored, but have started to deteriorate, you must store them in an area that is separate from other cellulose nitrate film storage areas.

Store cellulose nitrate films in vaults in single or double roll containers or in approved shipping containers. You will need to examine the entire length of nitrate films prior to vault storage. If they are stored with temperature and humidity controls, you should inspect nitrate films on a hand-rewind machine annually. Where storage conditions are not controlled, you should examine films every six months, or more frequently in warm climates. Any nitrate films you find in good condition can be returned to the storage vault. Any films that have progressed to the third stage of decomposition need to be destroyed at an approved facility.

## Projection

You need to exercise care when attempting to project cellulose nitrate films. Cellulose nitrate motion picture films may be brittle and shrunken. Do not attempt to unroll or project a cellulose nitrate film unless you are thoroughly familiar with its physical characteristics. Improper projection can damage or destroy the film.

Because of the potential fire hazards, the projection of cellulose nitrate films is not a common practice. You should project cellulose nitrate films only in specially designed enclosures using projectors with air-cooling systems. (Refer to design specifications in NFPA 40, Chapter 6.) Projection booths in older theaters were typically constructed with thick concrete walls, large steel doors mounted on rolling tracks, and explosion relief panels. Specialized projectors with fire-prevention rollers were also used.

Since decomposition is accelerated with high temperatures, projecting cellulose nitrate film *without* air-cooling systems will advance the decomposition stage. Therefore, do not return film that was exposed to high temperatures to your storage vault for long-term storage. You can reprint your film onto safety film and then send the cellulose nitrate film to an authorized facility to be destroyed.

## Repair and Duplication

Cellulose nitrate film repair and duplication services are not commonly offered. The following companies that provide these services are listed for your convenience but do not constitute a recommendation or endorsement by Kodak:

HFC Rejuvenation  
826 Seward  
Hollywood, CA 90038  
(213) 462-1971

ADF/Photogard/Durafilm  
Film Coating Laboratory  
1015 North Cahunga Blvd.  
Hollywood, CA 90038  
(213) 469-8141  
(Cleaning and physical  
repair only)

Cinema Arts Inc.  
P.O. Box 70  
South Sterling, PA 18460  
(717) 676-4145

Cine-Tech  
920 Allen Ave.  
Glendale, CA 91201  
(818) 242-2181

WRS Film & Video Labs  
100 Napor Blvd.  
Pittsburgh, PA 15205  
(412) 937-7700

YCM Labs  
2312 West Burbank Blvd.  
Burbank, CA 91506  
(818) 843-5300

## Transportation

Cellulose nitrate films that are shipped to a facility for storage, projection, duplication, or repair must meet special transportation requirements. Cellulose nitrate-based films are considered *hazardous materials* by the United States Department of Transportation (USDOT).

On the shipping papers that accompany the films, you are required to include the Shipping Name, Identification Number, Hazard Class, and Hazard Label:

Shipping Name	Films, Nitrocellulose base
Identification Number	UN 1324
Hazard Class	4.1
Hazard Label	Flammable solid

Package your cellulose nitrate films so that each reel of film is packed in a tightly closed inner metal can or in an inner packaging of strong cardboard or fiberboard. The inner packaging must be packed in one of the following outer packagings:

Outer Packaging Description	Specifications
Steel Drum	1A2
Aluminum Drum	1B2
Plywood Drum	1D
Fiber Drum*	1G
Steel Jerrican	3A2
Wooden Box	4C1, 4C2
Plywood Box	4D
Reconstituted Wood Box	4F
Fiberboard Box*	4G
Plastic Box*	4H2

\*Outer fiberboard or solid plastic boxes and fiber drums must be limited to a single reel of not over 600 meters (1,969 feet) of film.

USDOT may also allow additional types of shipping containers for transporting cellulose nitrate films. PRC offers a container that is an acceptable inner packaging for nitrocellulose-based films. These containers are available from Plastic Reel Corporation of America (PRC), Brisbin Avenue, Lyndhurst, New Jersey 07071, (201) 233-5100.

The shipping container must display a USDOT label, identifying that a flammable solid is being transported. Cellulose nitrate films can be transported in aircraft within the maximum limit of 25 Kg (55 pounds) on passenger aircraft or 100 Kg (220 pounds) on cargo aircraft. Vehicles or other public conveyance used for the transportation of passengers can be used for the transportation of cellulose nitrate film. Transportation using underground trains or subways is prohibited.

Cellulose nitrate films that are shipped to a facility for storage, projection, duplication, or repair must be transported by a carrier that is authorized by USDOT.

## WASTE MANAGEMENT AND DESTRUCTION

Cellulose nitrate films that have reached the third stage of decomposition, or have no historical value, need to be destroyed properly. Since these films decompose rapidly under certain conditions and are flammable, it is important that you store and transport these materials safely.

### Waste Classification

Once it is determined that a cellulose nitrate film needs to be destroyed, it is considered a waste. Under the Resource Conservation and Recovery Act (RCRA), all waste cellulose nitrate films should be classified as *hazardous wastes*. Cellulose nitrate

film that is designated for destruction must be identified as a hazardous waste using all applicable Environmental Protection Agency (EPA) Waste Codes. The EPA Waste Codes listed in the table below may apply to cellulose nitrate film.

Stable cellulose nitrate films designated for destruction or those that are in one of the first two stages of decomposition should be classified as a hazardous waste using EPA Hazardous Waste Codes D001 and D003. Cellulose nitrate films that are in one of the last three stages of decomposition should be classified as a hazardous waste using EPA Hazardous Waste Codes D001, D003, and D011.

### Hazardous Waste Storage

All cellulose nitrate films that are marked for destruction need to be stored and transported *under water*.

You will need to place them in a steel or plastic drum that meets USDOT specifications, and cover the films with water. The water must be more than 25 percent by weight of the total weight of the films. (Water weighs about 8 pounds per gallon.) Be sure to take into account the weight of any film reels.

When a cellulose nitrate-based film is designated for destruction, and is, therefore, a hazardous waste, RCRA requirements may apply to your storage facility. Long-term storage may require an RCRA permit. When a cellulose nitrate-based film is determined to be a hazardous waste, you should send it to an authorized waste-treatment facility for proper destruction as soon as possible.

EPA Waste Code	Definition
D001	A material is defined as an <b>ignitable hazardous waste</b> if it is an oxidizer as defined under USDOT regulations. Nitrate-containing materials are specifically defined as oxidizers under those provisions.
D003	A material is defined as a <b>reactive hazardous waste</b> if it is capable of detonation or explosive reaction when subjected to a strong initiating source or heated under confinement. Cellulose nitrate films meet this criteria; they will spontaneously ignite under elevated temperatures. The rate of combustion of nitrate films is about fifteen times that of wood, and the resulting intense fire is virtually impossible to control or easily extinguish.
D011	A material is defined as a <b>hazardous waste</b> possessing the characteristic of leachable toxicity for silver if, when exposed to the Toxicity Characteristic Leaching Procedure (TCLP), the material leaches $\geq 5$ mg/l (ppm) of silver. Typically, photographic films do not leach $\geq 5$ mg/l of silver when subjected to the TCLP. However, during decomposition, it is likely that more silver may be present during leaching once the film has reached the third stage of decomposition. The TCLP can also be performed on a representative sample of a film to define its characteristics.

## Hazardous Waste Transportation

The transportation of cellulose nitrate films is regulated by both the USDOT and the United States Environmental Protection Agency (USEPA). Cellulose nitrate-based films are considered *hazardous materials* under USDOT and *hazardous wastes* by USEPA.

You are required to include the Shipping Name, ID Number, Hazard Class, and Hazard Label on the shipping papers that accompany the films for destruction:

<b>Shipping Name</b>	Waste Nitrocellulose, wet with not less than 25% water, D001, D003, D011*
<b>Identification Number</b>	UN 2555
<b>Hazard Class</b>	4.1
<b>Hazard Label</b>	Flammable solid

\*Include EPA Waste Code D011 only for shipping those films that are in one of the last three stages of decomposition.

Package waste nitrocellulose-based films with not less than 25-percent water, and label as a flammable solid:

Packaging	Specifications
Steel drum	1A1, 1A2
Plastic drum	1H1, 1H2

Waste nitrocellulose-based films must be transported by a carrier that is authorized by USDOT and USEPA to transport hazardous waste. A hazardous waste manifest and a Land Disposal Restriction Form must accompany the material during transport.

### Destruction

Once your cellulose nitrate film is determined to be a hazardous waste, you need to ship it to a treatment facility as soon as possible, following the transportation requirements outlined above.

The appropriate treatment technology for cellulose nitrate film is *incineration*. The incinerating facility is required to have an RCRA permit to treat all EPA Hazardous Waste Numbers associated with your waste. This includes D001, D003, and possibly D011, depending on the decomposition stage of the film.

There are many facilities in the United States that are permitted to manage these types of waste. The following companies provide transportation and waste treatment. This list is provided for your convenience and does not constitute a recommendation or endorsement by Kodak:

ENSCO, Inc.  
Lincolnshire, IL  
Corporate Sales Offices  
(708) 945-5700

Ross Incineration  
Grafton, OH  
(800) 878-ROSS

Chem Waste Management, Inc.  
(800) 843-3604

WTS, Inc.  
640 Park Place  
Niagara Falls, NY  
(716) 282-4100



## REFERENCES

1. ISO/DIS 10356:  
Cinematography—Storage and Handling of Cellulose Nitrate Base film.
2. ANSI/NFPA 40 (1994 edition)  
Standard for the Storage and Handling of Cellulose Nitrate Motion Picture Film.
3. Hill, J.R., and Weber, C.G.,  
“Stability of Motion Picture Films as Determined by Accelerated Aging,” *Journal SMPTE*, vol. 27, 677-689 (1936).
4. Carroll, J.F., and Calhoun, J.M.,  
“Effect of Nitrogen Oxide Gases on Processed Acetate Film,” *Journal SMPTE*, vol. 64, 501-507 (1955).
5. Daily, J., “The Care and Handling of Hazardous Nitrate Film at UCLA’s Unique Projection Facilities,” *Journal SMPTE* 453-456, (1990).
6. Edge, M., Allen, N.S., Hayes, M., and Riley, P.N.K., “Mechanism of Deterioration in Cellulose Nitrate Base Archival Cinematographic Film,” *European Polymer Journal*, (1990).
7. KODAK Publication No. H-23 (1992): *The Book of Film Care*, Chapter 3, “Storage and Handling of Processed Nitrate Film,” pages 30-35.
8. Louvet, Alain, Ph.D.,  
Dissertation, “The Study on the Decomposition of Cellulose Nitrate Photographic Negatives,” December, 1994, de l’Université et Marie Curie, Paris, France.
9. Ram, A. Tulsi, Kopperl, D.F., Sehlin, R.C., Masaryk-Morris, S., Vincent, J.L., and Miller, P., “The Effects and Prevention of the ‘Vinegar Syndrome,’” *Journal of Imaging Science and Technology*, vol. 38, 249-261, May/June 1994.
10. Ram, A. Tulsi, Carroll-Yacoby, D.M., Miller, P., and Heuer, H.D., “The Status Report on the Worldwide Molecular Sieve Trade Test Results,” Paper presented at the AMIA meeting, Boston, MA, 1994, and at the FIAF meeting in London, U.K., January 1995. Under publication in *FIFA Journal*.
11. Adelstein, P.Z., Reilly, J.M., Nishimura, D.W., and Erbland, C.J., “Stability of Cellulose Ester Base Photographic Film: Part IV—Behavior of Nitrate Base Film,” *Journal SMPTE* 359-369, (1995).



## Kodak Environmental Services

### MORE INFORMATION

If you have environmental or safety questions about Kodak products or services, contact Kodak Environmental Services at (716) 477-3194, between 8 a.m. and 5 p.m. (Eastern time).

Kodak also maintains a 24-hour health hotline to answer questions about the safe handling of photographic chemicals. If you need health-related information about Kodak products, call (716) 722-5151.

Kodak has many publications to assist you with information on Kodak products, equipment, and methods. To obtain a list of Kodak publications, send your request for a copy of KODAK Publication No. L-1, *KODAK Index to Photographic Information*, with \$1 to Eastman Kodak Company, Department 412-L, Rochester, New York 14650-0532.

#### Introducing Kodak Information Center's Faxback System

—Available 24 hours a day, 7 days a week—

*Many technical support publications for Kodak products can be sent to your fax machine from the Kodak Information Center. Call:*

**1-800-242-2424, Ext. 33**

If you have questions about Kodak products, call Kodak.

*In the U.S.A.:*

*1-800-242-2424, Ext. 60  
Monday-Friday, 8 a.m.-8 p.m.  
(Eastern time)*

*In Canada:*

*1-800-465-6325  
Monday-Friday, 8:30 a.m.-5 p.m.  
(Eastern time)*

The information in this publication was compiled by the Motion Picture Television Imaging's Environmental Steering Committee to encourage and promote the preservation and safe handling of nitrate-based motion picture films.

This publication is printed on recycled paper that contains 50 percent recycled fiber and 10 percent post-consumer material.



**EASTMAN KODAK COMPANY • ROCHESTER, NY 14650**

Safe Handling, Storage, and Destruction of  
Nitrate-Based Motion Picture Films  
KODAK Publication No. H-182  
**CAT 801 2049**

Kodak and "e" mark are trademarks.

New 9-95-E  
Printed in U.S.A.