TECHNICAL REPORT

# ISO/TR 12031

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# Micrographics — Inspection of silver-gelatin microforms for evidence of deterioration

*Micrographie — Inspection des microformes en argent-gélatine pour mise en évidence de détérioration*

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# Contents

Page

## Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this Technical Report may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 12031 was prepared by Technical Committee ISO/TC 171, *Document imaging applications*, Subcommittee SC 1, *Quality*.

# Introduction

The purpose of this Technical Report is to provide a uniform method of selecting and inspecting silver-gelatin microforms for evidence of deterioration. Improper processing, handling, and storage conditions have long been known to promote biological attack and various other kinds of image degradation. Examination of some large collections of microfilmed records within the last decade has revealed a number of instances of spot blemishes. This may be influenced by the number of years and by the number of different processing conditions used. These instances serve to focus attention on the fact that, although film may be processed and stored in the best available conditions, the only assurance that such records are being well maintained is a systematic programme of careful inspection. Silver-gelatin microforms which have been manufactured, exposed, developed, and stored according to existing standards and which have a long life expectancy may not require extensive inspection.

# Micrographics — Inspection of silver-gelatin microforms for evidence of deterioration

## 1 Scope

This Technical Report applies to all forms of silver-gelatin microfilm, whether in roll, aperture card, jacket or microfiche format. It describes the equipment and procedures necessary to identify and monitor deterioration. This information serves to identify the extent and nature of the problem and will ultimately provide a sound basis for any remedial action that may be required.

## 2 References

ISO 417:1993, *Photography — Determination of residual thiosulfate and other related chemicals in processed photographic materials — Methods using iodine-amylose, methylene blue and silver sulfide.*

ISO 543:1990, *Photography — Photographic films — Specifications for safety film.*

ISO 2859-0:1995, *Sampling procedures for inspection by attributes — Part 0: Introduction to ISO 2895 attribute sampling system.*

ISO 2859-1:1999, *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.*

ISO 2859-2:1985, *Sampling procedures for inspection by attributes — Part 2: Sampling plans indexed by limiting quality (LQ) for isolated inspection.*

ISO 2859-3:1991, *Sampling procedures for inspection by attributes — Part 3: Skip-lot sampling procedures.*

ISO 5466:1996, *Photography — Processed safety photographic film — Storage practices.*

ISO 6196-1:1980, *Micrographics — Vocabulary — Part 01: General terms.*

ISO 10602:1995, *Photography — Processed silver-gelatin type black-and-white films — Specifications for stability.*

## 3 Terms and definitions

For the purpose of this Technical Report, the terms and definitions given in ISO 6196-1 and the following apply.

**3.1**
**frilling**
separation of the emulsion from the film base during initial processing

# 4 Inspection conditions

The inspection room or location selected for inspection should be clean with a relatively dust-free atmosphere and the temperature should not exceed 23 °C and relative humidity should not exceed 50 %. The work-top area should be clean and free of objects and substances that might damage the microfilm.

Changes in temperature and/or humidity during inspection or during transportation from the film storage facility to inspection room should be avoided.

# 5 Equipment and supplies

## 5.1 General

The inspection equipment should be such that the film cannot be damaged during the inspection process.

## 5.2 Light box and film rewinds for 16 mm and 35 mm film

Light boxes of this nature usually are equipped with a light source covered by translucent glass or plastic. Fluorescent lights can be used to minimize the heat build-up of the inspection station. Tungsten or tungsten-halogen lights can also be used.

## 5.3 Eye loupe (eye glass)

Two eye loupes with magnification of approximately 5× and 15× should be used. The lower magnification will provide a wider field of view, while the higher magnification will allow much closer inspection of specific defects.

## 5.4 Microscope

A microscope with a magnification capability of at least 25× and 50× will be required for occasional close examination. A fairly intense substage illuminator is essential to penetrate the high density areas of the leader and trailer. A microscope having a surface illuminator may be helpful in evaluating surface characteristics. A camera to take photomicrographs of the defects may be helpful to record progression of any deterioration of the microfilm.

## 5.5 Specular light source

Another light source other than room ambient light should be available to inspect the film surface with and without magnification for image degradation, scratches and other defects. This light source is necessary for microfiche, jackets, aperture cards and roll film.

## 5.6 Black velvet

Placing a swatch of black velvet behind the film may be of help for detecting scratches, water spots, and abrasions.

## 5.7 Inspection gloves

Clean, lint-free white cotton or nylon gloves should be worn to avoid marking the film with fingerprints. These gloves should be used exclusively for this purpose. It is highly recommended that the gloves be changed regularly.

# 6 Sampling method

## 6.1 General

It is preferable that each film be inspected. If this is not possible, a suitable sampling procedure as given in ISO 2859 should be used to provide representative data of the total population of the group or lot sample.

## 6.2 Division into survey groups

The collection should be divided into groups of similar types. Examples of such similarities are groups stored under the same conditions; similar film sizes such as 16 mm and 35 mm; similar formats and film types, i.e. jackets, aperture cards, polyester film, and acetate film; record series type; etc. As most types of deterioration seem to be progressive with age, some form of separation by date may be significant. In a library or archives setting, an ongoing collection of newspaper files or a series of books or private papers microfilmed over a specific period of time could be considered a significant lot or group.

# 7 Inspection procedures

## 7.1 General

The microfilm inspector should be thoroughly familiar with the various types of ageing defects as well as defects normally associated with film processing (see clause 9). The inspector should also be aware that older film should be treated carefully until it has been established that normal handling will not damage the film.

## 7.2 Procedure for all microforms

Both sides of the film should be examined.

Rotate film so that the light reflects off the film surface.

Examine the reverse side of the film. Some forms of deterioration can be detected with the unaided eye at this initial stage.

Some defects are more easily seen over the light boxes, without the aid of an eye loupe, while others need to be viewed under stronger magnification. Inspection procedures for microforms having higher reduction ratios may require more critical evaluation.

The inspector should carefully examine the film using both transmitted and reflected light. To detect scratches inspection should be made through film illuminated from behind and toward black velvet.

## 7.3 Checks for all microforms

Verify that the base is not cellulose nitrate (see annex A.)

NOTE The base of some older collections may be cellulose nitrate.

Smell the film, the carrier, and inside the container for unusual odours. Check especially for acetic odour with triacetate base film.

Check the constitution of the film surface, especially for scratches, coverings, fungus, or coating separation.

Check to see if storage containers, such as film boxes, storage cabinets, and other containers, show any signs of deterioration.

### 7.4 Additional checks for roll film

Holding the centre of the reel between thumb and index finger, turn the reel with the free hand so that the leader falls free. If it does not fall free, carefully determine the reason. It is not unusual for film that has not been unwound for a long time period to stick slightly. If the leader and following coil cannot be freed without damaging the film, the inspector should consult a film specialist.

Holding the reel in one hand, unwind sufficient leader to examine the black area in the ambient room light for evidence of a silver sheen on the emulsion side of the film.

Place the roll of film on the rewinds with the emulsion side facing up, and slowly advance the film over the light box. At approximately every 3 m of film, stop the film to carefully examine the images with the aid of the eye loupe or microscope, using both transmitted and reflected light for evidence of deterioration on the emulsion side of the film.

Check roll film for possible defective splices due to improper tape or splicing procedures, and for improper material or adhesives that may cause defects.

### 7.5 Additional checks for jackets

Examine the carrier in ambient room light. The channel joiners may become separated and consequently unable to retain the images in the proper channel.

Check the channel for dust and soiling. The channel and film should not stick together; sticking would indicate improper drying, too-moist storage conditions or films that have been stored in very close contact between film surface and jacket materials due to very flat surfaces, etc.

Pay particular attention to the image on the extreme right edge, next to the loading slot because this image is often more exposed to the environment air.

### 7.6 Additional checks for aperture cards

Examine the carrier in ambient room light. Examine the card stock for evidence of deterioration. Some of the adhesives used in older stock may have not aged well. In addition to the image quality, the edges of the film should be checked for possible deterioration.

## 8 Inspection reporting

### 8.1 Classification

The inspector should complete the inspection report form. Subjective judgement is required to assess the overall condition rating of the film, using the following categories:

a) *Excellent*, no deterioration detectable;

b) *Acceptable*, minor physical damage without impairment of the information;

c) *Poor*, film shows deterioration such as discoloration: if the information is not impaired, the film can be stored again. The film should, however, be checked every two years for further deterioration;

d) *Bad*, information has been impaired and a replacement silver duplicate should be made to prevent further loss of information.

NOTE Other films of the same series or manufacturing date should be checked for deterioration as well.

## 8.2 Data collection, general

The most desirable kind of report may differ from organization to organization, and the factors of interest may change as the inspection programme progresses. It is recommended, however, that at least two reporting forms be used: the first to record the basic condition and history of a defined lot or group, and the second to record the findings of the individual microform inspection.

## 8.3 History and description of group or collection

The following are considered to be the desirable data requirements to identify a group or collection:

a) name of organization. This will in all likelihood be included in the form title. However, in the case of records centres or archives, it will be necessary to include a section for the department or agency involved;

b) record series, group, or collection identification;

c) film identification, sufficient information to retrieve the film series or collection again;

d) name of inspector and date of inspection;

e) film carrier if not roll

EXAMPLE jacket and manufacturer, aperture card and manufacturer;

f) year produced

EXAMPLE 1966, 1970, etc.;

g) film type

EXAMPLE camera negative, duplicate negative, duplicate positive;

h) film base

EXAMPLE polyester, acetate;

i) film size and thickness

EXAMPLE 16 mm, 35 mm, thin, thick;

j) film usage

EXAMPLE long term, intermediate master;

k) type of reel, spool, core

EXAMPLE plastic, metal.

Optional:

a) film format

EXAMPLE roll, jackets, aperture cards;

b) processed by

EXAMPLE in-house, vendor, unknown;

c) film container

EXAMPLE cardboard box, plastic box, metal can, etc.;

d) environmental conditions: describe heat and humidity ranges, impurities in the environment if known (see ISO 5466).

## 8.4 Individual microform inspection report

The following are the desirable data requirements for the initial inspections and any subsequent inspections of individual units within a group or collection:

a) record series, group, or collection identification;

b) film identification, sufficient information to retrieve the film again;

c) name of inspector and date of inspection;

d) type of leader

EXAMPLE fogged, clear, or spliced;

e) type of trailer

EXAMPLE fogged, clear, or spliced;

f) resolution

EXAMPLE 5,6 line pairs;

g) number and type of splices

EXAMPLE tape, glue, heat, etc.;

h) type of restrainer used to confine the film

EXAMPLE rubber band, tape, string, plastic clip, etc.

NOTE Any or all of these restrainers may damage film.

i) type of deterioration: mould, discoloration (silvering, yellowing, bluing, and mirroring), scratches, redox blemishes, separation of emulsion, evidence of adhesion, etc.;

j) location of deterioration: leader, image area background, character area, first channel of jacket, upper left corner of aperture card, first ten feet, whole roll, trailer, etc.;

k) severity of deterioration (see inspection classification);

l) remarks

EXAMPLE further sampling required, duplication required, examine all other microforms dated before 1965, examine all microfilms generated in the city of Manassas, etc.;

m) overall assessment of physical condition (include inspector's comments, if desired) — excellent, acceptable, etc.

## 8.5 Data analysis (optional)

Data analysis should include the following information:

a) name of lot, group, or collection;

b) inspection dates, beginning to end;

c) name of inspector(s);

d) number of units in lot — rolls, cards, jackets, microfiche;

e) number of samples inspected;

f) type(s) of deterioration detected;

g) percentage of microforms in sample affected by deterioration;

h) severity of deterioration;

i) remedial action:

   1) further inspection of this lot at this time only;

   2) change leader/trailer only at this time;

   3) recommendation for changes to storage facility or container or packaging;

   4) recommendation for copying;

   5) referral to professional restoration;

   6) recommendation for sulphiding treatments.

If no immediate action is recommended other than a second inspection at a later specified date, hard copy prints of the defect should be taken and preserved for further comparison.

# 9 Types of defects

## 9.1 General

The following is a description of the more common types of defects usually associated with poor storage conditions or defects which do not become apparent until after storage. For information regarding factors which can affect deterioration, see annex B.

## 9.2 Microbiological growths

When photographic films are stored for any length of time in an atmosphere having a relative humidity generally above 50 %, there is a tendency for fungus (often called mould or mildew) to grow on either the emulsion surface or the back of the film or on the film reel. Fungus spores are found in the surrounding air and are usually quite harmless in a dry, cool environment. However, under conditions of warmth, about 21 °C, and a relative humidity above 50 %, they become very active, multiplying rapidly and attacking the organic gelatin of the film.

Damage to the film usually takes the form of distortion of the emulsion, perhaps best described as an etching action, similar to a printer's engraving process, and eventually causes chemical breakdown so that the gelatin becomes sticky and readily soluble in water (see Figures C.1, C.2, C.3, and C.4). Water or water solutions should not be used for removal of fungus growth because either may lead to disintegration of the image. Damage to the emulsion is usually permanent. Most minor surface fungus can be removed by gently wiping with soft plush cotton moistened with an approved film cleaning liquid. Refer to manufacturers' warning when using cleaning fluids. Some

chemical treatments are being tested which may also retard the spread of fungus. Serious damage should be referred to professional photographic technicians.

## 9.3 Redox blemishes

Redox blemishes, sometimes referred to as measles, microscopic spots or ageing spots, are a phenomenon first reported in 1963. These spots are small, 15 µm to 150 µm in diameter, reddish or yellowish in colour and may be circular, with a tiny nucleus at their centre, or irregular in shape.

These spots are believed to be caused by local oxidation of image silver, resulting in the formation of minute deposits of colloidal silver appearing as red or yellow spots. Possible oxidizing agents that cause this degradation are aerial oxygen, atmospheric contaminants such as peroxides, ozone, sulphur dioxide, hydrogen sulphide, or others, that occur in industrial atmospheres. Peroxides may be present in some woods and may also be formed as a result of the ageing of paper inserts and cardboard containers commonly used in storing film.

Blemishes can appear in less than one year of storage, depending on storage conditions, such as high humidity and warm temperatures, a combination of which appears to increase the rate of blemish formation. Research conducted during the 1960s indicated that these blemishes are present on, but not confined to, negative microfilm and spliced positive film. Although most observations have been made on roll film, some cases have been reported on microfilm jackets and aperture cards which had been interfiled with some types of index cards.

While blemishes can form in different areas of the film depending on a number of different factors, they usually form initially in the exposed leader of the film (see Figure C.5) and in some cases may be observed as a silver sheen on the emulsion side with the unaided eye in ambient room light (see Figure C.6). The individual spots, however, can be examined with the aid of an eye loupe from either the emulsion or base side.

Film that has edge fog is particularly susceptible by providing a highway for the blemishes to migrate to the image areas of the film. Scratches in the emulsion seem to provide excellent areas for the oxidation process to form rapidly. If affected, older films seem to have the heaviest concentration of blemishes.

The common denominator for redox blemishes is the reddish/yellowish colour in each spot, which is derived from the colloidal silver. In severe cases, the colour is so vividly prominent that magnification is not needed to identify their presence. Other types of spots may occur on film from time to time which are not "redox." However, they are usually void of colour.

NOTE It is not necessary to report the different types of spots, just that they exist.

## 9.4 Residual processing chemicals

In the fixing step of the photographic processing, the undeveloped silver halide crystals in the emulsion are converted to soluble silver compounds which can be washed away with water. The chemicals most commonly used for fixing are sodium or ammonium thiosulphate (commonly called "hypo"). The fixing bath may also contain other chemicals to maintain a desirable pH, provide hardening, stabilize the solution, or protect the image from microscopic blemishes.

Adequate fixing and washing are essential to the permanence of microfilm. After all of the undeveloped silver halide has been converted, the emulsion is still saturated with the chemicals of the fixing bath and some dissolved silver compounds. If excessive amounts are not removed by washing, they would slowly decompose and attack the image, causing discoloration, usually in the form of a yellowish/brownish, irregular-shaped stain and subsequently cause fading of the image. This effect is accelerated greatly by high humidity and temperature. Also, the smaller the grain size of the film, the greater is the reaction. Since most microfilms are composed of very fine grains, they are very sensitive to this effect.

The formation of white powder on the outer convolution of the roll of film may indicate the presence of harmful acidic gases or may be the result of residual sulphur used in the manufacturing of rubber bands and paper containers or cellulose triacetate base decomposition.

The presence of black particles or dark streaks throughout the roll or film may indicate incomplete removal of the back coating material used on dye back film which was quite popular in the 1950s and 1960s.

### 9.5 Emulsion adhesion

One property of film on polyethylene terephthalate (polyester) base which requires consideration is that of the adhesion of the photographic and backing layers to this base. Of importance is the effect of very low relative humidity, which causes the gelatin photographic and backing layers to contract and imposes severe stresses on the gelatin adhesion. Cycling of relative humidity from moderate to very low (below 30 percent) causes alternate expansion and contraction of the gelatin layers, which can be particularly severe on the adhesive bond. The magnitude of this stress on the bond is very dependent on the thickness and physical characteristics of the gelatin layers, which differ with each type of film.

Under extreme conditions of elevated temperature and low or cycling relative humidity, gelatin photographic layers and backing layers on polyester bases sometimes develop adhesion defects, such as slight edge peeling, flaking, emulsion cracking, etc., while similar layers on cellulose ester base under the same conditions do not exhibit these defects or do so to a lesser degree. For this reason, the relative humidity is extremely important for permanent record storage. The recommended environmental conditions for archival storage are temperatures less than 21°C and a relative humidity between 20 % and 30 % (see ISO 5466.) It is essential that polyester base films for permanent records are stored under proper storage conditions.

### 9.6 Separation of the emulsion from the film base

This defect typically occurs on roll film and is the result of the base sticking or, in severe cases, gluing itself to the emulsion of the next coil and consequently is sometimes referred to as "fused film" or as "blocking." It is usually caused by:

— improperly dried film wound onto reels/spools and subsequently stored;

— storage in an environment of very high humidity;

— the dried residue of microbiological growth. Separation usually occurs when untrained persons attempt to unwind severe cases (see Figures C.7 and C.8).

NOTE Separation of the emulsion from the film base may also occur during initial processing and is referred to as "frilling".

### 9.7 Brittleness

Brittleness is usually caused by storage of the microfilm in very warm and dry conditions resulting in the loss of natural moisture from the film. Under these conditions the microfilm has a tendency to break or crack easily when bent. Often the film can be reconditioned by placing the film in an environment of 45 % to 50 % relative humidity for 48 hours. Severe cases may require five to 10 days to restore proper moisture content.

### 9.8 Base shrinkage

Base shrinkage is found mainly with acetate film and occurs when the plasticizer has evaporated from the base. The inspector should look for any kind of wrinkling on the emulsion or an acidic smell (see Figure C.7).

## 10 Remedial action

### 10.1 General

Remedial action to be taken should be determined by the extent of deterioration found in the initial inspection. Film in excellent condition and stored in long-term conditions will need no remedial action and may not need as frequent or as extensive re-inspections as film that exhibits deterioration in the first inspection or is not stored in long-term conditions. In either case, subsequent inspections should include both some reels previously inspected to determine if the condition of the film has shown additional deterioration, together with some reels not previously inspected.

The spread of redox blemishes on film rated as passable may be retarded by the replacement of leaders and trailers. Some chemical treatments are available which may also retard their spread. Minor forms of deterioration on film rated as fair may be corrected with approved cleaning materials, although duplication is recommended. Refer to manufacturers' warnings when using cleaning materials. Information loss cannot be restored on film rated as bad. An inspection should be made immediately of all film with similar characteristics and the film rated as acceptable, poor, or bad. Bad film should be duplicated immediately in order to salvage the remaining information. Poor films should be checked every two years for further deterioration.

The solution to these problems lies in preventive measures. Detection of any form of deterioration described in this document should be interpreted as an indication of improper processing, unsafe storage conditions, or inferior packaging materials, etc. An evaluation of the storage facility and packing containers should be made, and film should be transferred to long-term storage facilities and packing containers as soon as possible. Any corrective action should be implemented immediately.

If cellulose nitrate base film is identified, duplicates should be made and the originals properly destroyed. If it is not possible to make a duplicate due to the deterioration, the originals must be stored separate from the rest of the collection taking all necessary safety precautions.

## 10.2 Subsequent re-inspections

The condition of the survey group will determine subsequent actions and re-inspections. For example, survey groups that have exhibited no forms of deterioration and are stored under ideal conditions may not need to be re-inspected for up to two years, while additional samples should be taken from lots containing film in fair condition or the entire lot should be inspected immediately when samples have been found which were rated as bad.

# Annex A

# Determination of base type

The field test given in the Annex may be used for quickly identifying most photographic films as safety or nitrate without technical equipment or the expenditure of large amounts of specimen film.

**WARNING — The following test may be dangerous, and should only be carried out under controlled conditions by trained staff.**

Cut a piece of film approximately 16 mm wide and 35 mm long. Bend the film lengthwise and crease it sufficiently that when released it will stand upright. Stand the film sample (with the crease vertical) on a fire-resistant, flat surface such as an ashtray, glass plate, concrete floor, etc. This should be done at a safe distance from all film stocks. With a match flame, ignite one of the top corners of the film. Anyone unfamiliar with the burning of safety and nitrate photographic films should first conduct this test on samples of both types of film, the identities of which are known. If the film ignites easily, burns downward rapidly and vigorously with a bright yellow flame, and is completely consumed in less than 15 s, it probably contains dangerous quantities of cellulose nitrate.

If the sample ignites with difficulty and burns only partially, or burns completely in a time not under 15 s then its classification as safety film may be considered probable (see ISO 543).

# Annex B

# Factors affecting deterioration

## B.1 General

Deterioration of archival microfilm may occur for any one of the following reasons.

## B.2 Inappropriate choice of film material

Choose only film intended for long-term storage and which complies with ISO 10602.

## B.3 Processing

### B.3.1 Improper fixing

Insufficient fixing time or use of depleted fixer will leave too much residual silver and/or residual thiosulphate on the film.

Residual silver appears as a reflecting, shiny, black metallic coating. A subsequent removal is nearly impossible, so such film should not be stored.

An elevated residual sulphate content can be determined only by an ISO 417 test. Film with a high level of residual thiosulphate is not considered long term.

### B.3.2 Improper washing

Residual chemicals on the film, especially residual thiosulphate, which is a result of insufficient washing can adversely effect render long-term storage.

### B.3.3 Insufficient drying

As a result of insufficient drying, residual moisture remains on the film, which can cause the film to stick together when being unrolled. This can result in the separation of the emulsion, which destroys the information on the film.

Residual moisture on film (which may not cause sticking) produces a moist condition in closed film containers, which promotes bacterial damage. The information on the film can also be destroyed in this manner.

## B.4 Improper climatic conditions during storage

Non-compliance with the ISO prescribed storage conditions can result in film deterioration due to overly warm moist conditions and unclean ambient air, which can impair the information.

# Annex C

# Examples of types of defects

## C.1 Microbiological growths

Figures C.1 to C.4 give examples of microbiological attack (see 9.2).

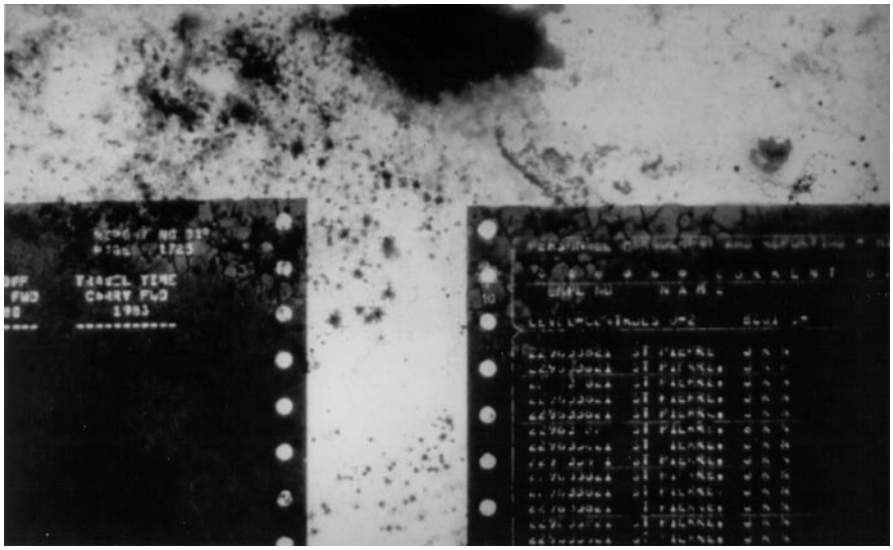

**Figure C.1 — Fungus actively growing**

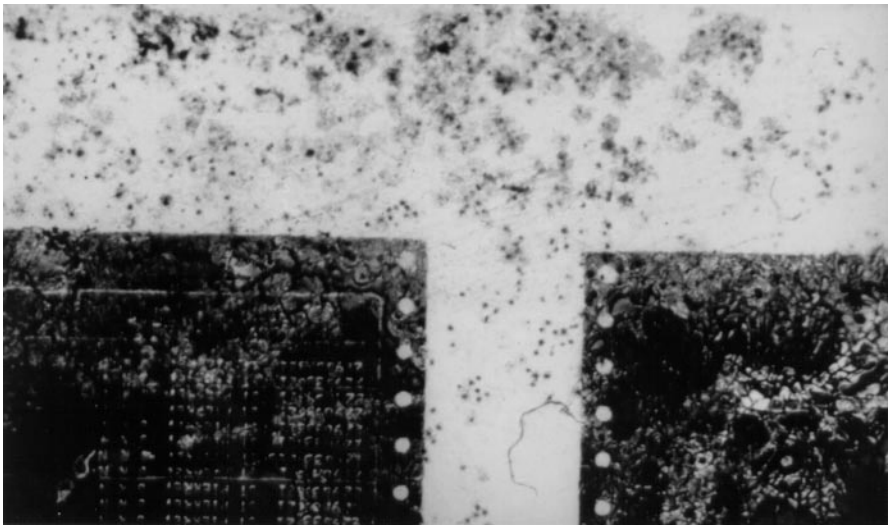

**Figure C.2 — Fungus beginning to destroy the emulsion**

**Figure C.3 — An extreme case of destruction showing the solubility of the emulsion**

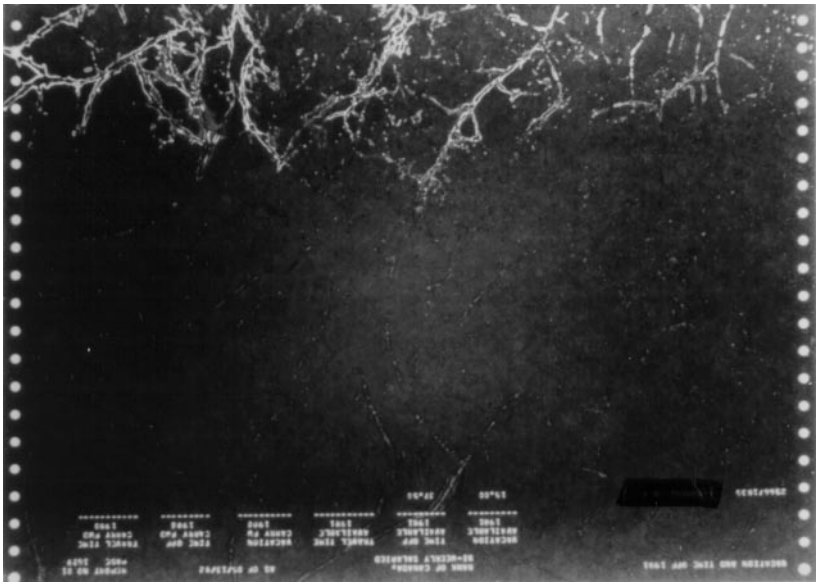

**Figure C.4 — Etching action of the fungus after clean up**

## C.2 Redox blemishes

Figures C.5 to C.6 give examples of Redox blemishes (see 9.3).

### C.2.1 Exposed leader

Figure C.5 gives an example of formation on exposed leader where $D_{max}$ shades to $D_{min}$; long coloured streak is evidence of scratches.

**Figure C.5 — Exposed leader**

### C.2.2 Silver sheen

Figures C.6 give an example of Silver sheen shown on fogged leader in ambient room light without magnification.

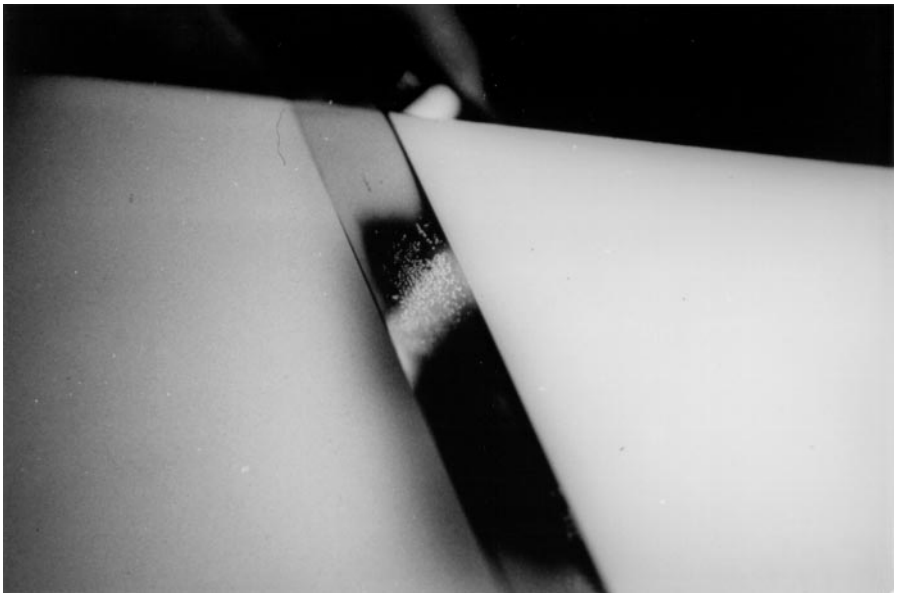

**Figure C.6 — Silver sheen**

## C.3 Separation of the emulsion from the film base

Figures C.7 and C.8 give examples of separation of the emulsion from the film base (see 9.6). Figure C.7 clearly shows separation of emulsion from base and Figure C.8 shows fusion of upper and lower level of strip from ill-advised attempt to unwind the film.

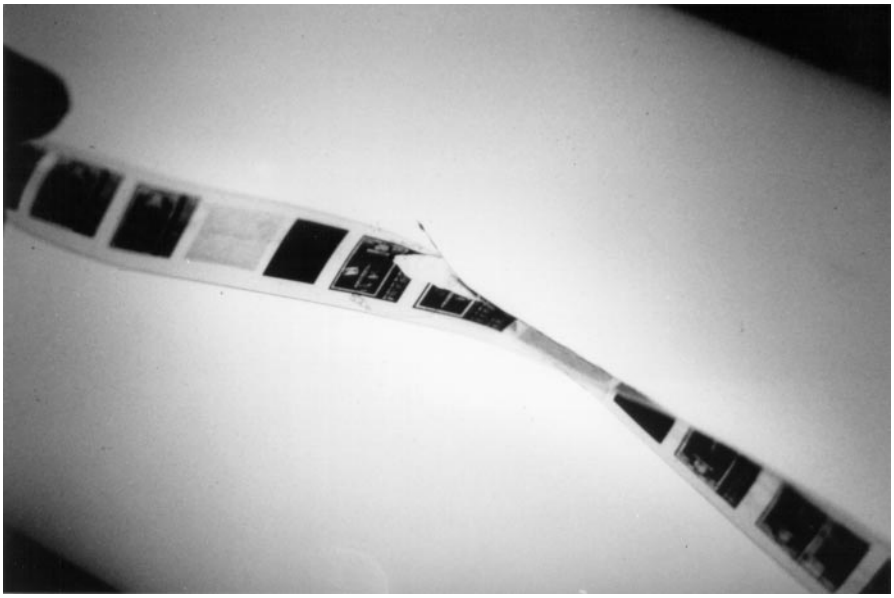

**Figure C.7 — Separation of the emulsion from base**

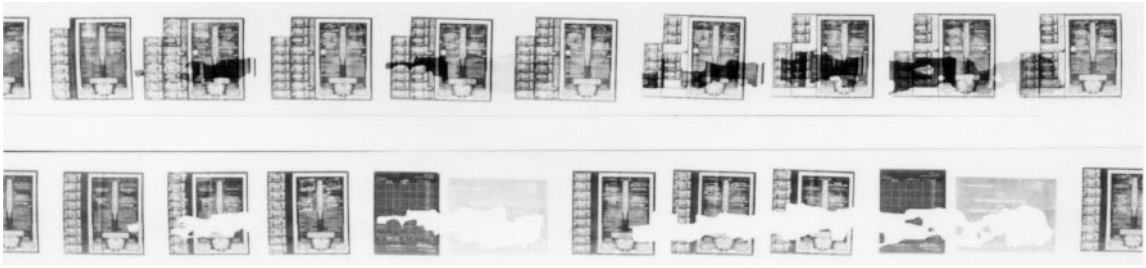

**Figure C.8 — Fusion of layers**

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