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WASHINGTON, D.C.

Recommended Practice for Inspection of Stored Silver-Gelatin Microforms for Evidence of Deterioration

Standard

Approved As

AMERICAN NATIONAL STANDARD

January 22, 1990

ANSI/AIIM MS45-1990

AIIM

Association for Information and Image Management

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ANSI/AIIM MS45-1990

Standard for Information and Image Management —

Recommended Practice for Inspection of Stored Silver-Gelatin Microforms for Evidence of Deterioration

Association for Information and Image Management

This recommended practice 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 observe and identify the various types of deterioration known to the industry.

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Table of Contents

Table

Appendices

Foreword

(This foreword is not part of American National Standard for Information and Image Management—Recommended Practice for Inspection of Stored Silver-Gelatin Microforms for Evidence of Deterioration, ANSI/AIIM MS45-1990)

The purpose of this document is to provide a uniform method of selecting and inspecting silver-gelatin microforms for evidence of deterioration. It applies to microfilm being stored by federal, state, local, and other public institutions, as well as private and nonpublic organizations.

Improper processing and storage conditions have long been known to promote biological attack and various other kinds of image degradation. Examinations of some large collections of microfilmed records within the last decade have revealed a number of instances of spot blemishes. 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 program of careful inspection.

Suggestions for improvement in this recommended practice based on experience in its use are invited. Suggestions should be sent to the Chairman, AIIM Standards Board, Association for Information and Image Management, 1100 Wayne Avenue, Suite 1100, Silver Spring, Maryland 20910. At the time this report was approved, the Standards Board had the following members:

Marilyn Courtot, Chairman
Thomas E. Berney
Don Klosterboer
E. Brien Lewis
Alan S. Linden
Wesley J. Micket
L. Don Prince
George Thoma
Charles F. Touchton
Herbert J. White II

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This recommended practice was prepared in response to a proposal by AIIM's C18 Public Record Microforms Committee. At the time the document was approved the committee consisted of the following members:

Organization	Representative
Virginia State Library and Archives	Richard M. Harrington, Chair
Genealogical Society of Utah	Brent Reber, Vice Chair
Bank of Canada	Donald G. Wilson
Business Records Corporation	Douglas P. Allen
Consultant	Tom Berney
Consultant	Edward N. Johnson
Consultant	Lester Kruger
Consultant	Albert H. Leisinger
Consultant	Herb Wehling
Genealogical Society of Utah	Eric Erikson
Jorm Microlab, Inc.	Stephen C. Kemble
3M Company	Carl J. Anderson
3M Company	Frederick W. Telke
Massachusetts State Archives	Albert H. Whitaker
Mayo Clinic Library	Clark W. Nelson
MSTC, Inc.	Robert Starbird
National Center for State Courts	Thomas G. Dibble
Nebraska Records Management Division	William Ptacek
Pennsylvania State Archives	Frank Suran
Somervell & Associates	Judy G. Somervell
South Carolina Archives	George M. Reid
Vermont Yankee Nuclear	Cherron Faulkner
Virginia Retirement System	John B. Breeden
Zytron Corporation	William E. Neale

A special subcommittee C18.1 Inspection of Stored Microfilms was given the assignment to develop this document. This document is in large measure the result of the initial draft by Donald G. Wilson. At the time the document was approved C18.1 had the following members:

Organization	Representative
Virginia Retirement System	John B. Breeden, Chair
Virginia State Library and Archives	Richard M. Harrington
Bank of Canada	Donald G. Wilson
Genealogical Society of Utah	Brent Reber
MSTC	Robert Starbird
National Archives and Records Administration	Alan Calmes
National Institute of Standards and Technology	Thomas Bagg
University Microfilms International	Robert Mottice

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American National Standard for Information and Image Management—Recommended Practice for Inspection of Stored Silver-Gelatin Microforms for Evidence of Deterioration, ANSI/AIIM MS45-1990

1 Scope

This recommended practice 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 observe and identify the various types of deterioration known to the industry. 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 indicated. This recommended practice does not apply to nitrate film.

2 References

All standards are subject to revision. When the following documents are superseded by an approved revision, that revision may apply.

2.1 Referenced American National Standards

ANSI PH1.43-1985. Photography (Film)—Processed Safety Film—Storage.

ANSI/AIIM MS23-1983. Information and Image Management—Practice for Operational Procedures/Inspection and Quality Control of First-Generation, Silver-Gelatin Microfilm of Documents.

2.2 Other Referenced Publications

AIIM TR2-1980. Information and Image Management Technical Report—Glossary of Micrographics.

2.3 Related American National Standards

ANSI IT9.1-1989. Imaging Media (Film)—Silver Gelatin Type—Specifications for Stability.

ANSI IT9.2-1988. Imaging Media—Photographic Processed Films, Plates, and Papers—Filing Enclosures and Storage Containers.

2.4 Other Related Publications

Special Interest Package No.34: Microspots and Aging Blemishes. Silver Spring, Md.: Association for Information and Image Management, 1987.

Inspection of Microfilm Rolls from the Public Archives Collections for Redox Blemishes and Testing for Residual Processing Chemicals, Canada 1977.

3 Definitions

Definitions essential for clarification of this recommended practice may be found in AIIM TR2-1980.

4 Sampling Method

4.1 General. In some cases, particularly in small collections of microfilm, the best method may be to inspect every roll or jacket, etc., but in most cases it will not be practical nor cost effective. Therefore, a system of random sampling must be introduced which will provide data that can be relied upon to be representative of the total population of the group or lot sample in order to draw inference about that population.

4.2 Division Into Survey Groups. The first step is to divide the collection 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 purchased on microfilm over a specific period of time could be considered a significant lot or group.

4.3 Size of Sample. The sample should be 1/1000th of the group or at least 100 microforms (rolls, jackets, aperture cards, microfiche), whichever is greater. The whole group should be inspected if there are fewer than 100 microforms. The minimum sample size is based upon the desired accuracy of the estimate of total incidence as derived from the sample. The accuracy of the determination does not increase in proportion to the increase in the size of the sample. Thus, additional expenditure of time and effort beyond the minimum is hardly justified.

It is necessary that sampling procedures be established by the inspecting authority before the program begins which will assure that all parts of the group are represented. For example, if 100 rolls are to be selected from 300 drawers, one roll might be taken from every third drawer. Each roll should be taken from the center or some other easily identifiable position in the drawer. For another example, if 100 microfiche are to be selected from four cabinet drawers, 25 should be selected from each drawer to ensure that any one of them has an equal chance at being selected. The establishment of the sampling pattern

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in advance prevents an inspector from unconsciously introducing a bias in the sampling by selecting rolls which have some distinguishing characteristic. Alternatively, if the units are numbered, as should normally be the case, a random number generator may be purchased or created. Data processing centers are often consulted for this type of service.

5 Equipment and Supplies

5.1 Inspection Room or Location. The room or location selected as the site for inspection should be clean with a relatively dust free atmosphere and with a temperature not to exceed 21°C (70°F) and a relative humidity of 50 percent — the normal office environment (see 7.5). Smoking should not be allowed in the inspection room. Where possible the inspection room should be located in close proximity to the storage area which would reduce the possibility of damage during the packing and carting of microforms to a remote location.

5.2 Reporting Forms. See Sections 6.4, 6.5, 6.6, and Appendices C and D.

5.3 Light Box and Film Rewinds to Accommodate 16/35 mm Rolls. Light boxes of this nature usually are equipped with fluorescent lights surmounted by translucent glass or plastic.

5.4 Eye Loupe with Magnification of Approximately 5 to 15X. Two loupes are ideal. The lower magnification will provide a wider field of view while the higher magnification will allow much closer inspection of specific defects.

5.5 Specular Light Source. Another light source other than room ambient light, should be available to inspect the film surface under magnification for resolution degradation, scratches and other defects.

5.6 Microscope. A microscope with a magnification capability of between 25X and 50X will be required for occasional close examination. A fairly intense substage illuminator is essential however, to penetrate the high density areas of the leader and trailer. A microscopic stage film holder with 16 mm and 35 mm film guides is very helpful, although not essential.

5.7 Densitometer. A densitometer should be available to inspect the microforms for degradation of density.

5.8 Spare 16/35 mm Take Up Reels. (100 foot capacity.) (Only needed for roll film.)

5.9 Inspection Gloves. *Clean, lint-free white cotton or nylon gloves must be worn to avoid marking the film with fingerprints.*

5.10 Inspection Station. An ideal inspection station will allow the microscope and light box to move in or out of the film path between the rewinds as and when required.

6 Inspection Procedures

6.1 General. Microfilm inspectors should be thoroughly familiar with the various types of aging defects as described in Section 7 as well as defects normally associated with film processing described in ANSI/AIIM MS23-1983. 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.

6.2 Roll Film. Select a roll of film and remove it from its container. Smell the film, the reel, and inside the container for unusual odors. Inspectors who have allergies or are susceptable to infection should use caution. Holding the center of the reel between thumb and index finger turn the reel with the free hand so that the leader may fall 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 period of time to stick slightly. If the leader and following convolution cannot be freed without damaging the film, the inspector should consult a photographic technician.

Holding the reel in one hand, unwind sufficient leader to examine the fogged (black) area in the ambient room light. Rotate the 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. Examine the resolution, if resolution targets were filmed. Take a density reading from the first image that is not fogged, covered with characters, etc. These readings can be compared to readings recorded when the film was produced, if available, and to subsequent reinspections to determine if the density or resolution has deteriorated. This deterioration would provide a warning of other problems.

Place the roll of film on the rewinds with the emulsion facing up, and slowly advance the film over the light box. Some defects are more easily seen over the light box without the aid of an eye loupe, while others must be viewed under stronger magnification. Approximately every 3 meters (10 feet), the inspector should stop the film to carefully examine the images with the aid of an eye loupe or microscope using both transmitted and reflected light. Both sides of the film should be examined each time for the defects described in Section 7.

6.3 Unitized Microforms

6.3.1 Aperture Card. Select an aperture card and examine the carrier in the ambient room light. Examine

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the card stock for evidence of deterioration particularly in the aperture area of the film. Some of the adhesives used in older stock may not have aged well. Place the aperture card on the illuminated light box and make a general observation of its state of preservation. With the aid of the eye loupe, examine at least three different locations on the aperture film. With the aid of the microscope perform the same examination. Both sides of the aperture card should be examined for defects described in Section 7. Take a density reading from a portion of the image that is not covered with characters. This reading can be compared to readings recorded when the film was produced, if available, and to subsequent reinspections to determine if the density has deteriorated. This deterioration would provide a warning of other problems.

6.3.2 Jacket. Select a jacket and examine the carrier in ambient room light. The channel joiners may become separated and consequently unable to retain the images in the proper channel or in some cases the carrier fabric may stick to the surface of the film. Proceed cautiously until a determination has been made. Place the jacket on the illuminated light box and make a general observation of its state of preservation. With the aid of the eye loupe, examine at least one randomly selected image per channel. With the aid of the microscope, perform the same examination. Pay particular attention to the image on the extreme right edge, next to the loading slot because this image is often more exposed to environmental air. Both sides of the jacket should be examined for defects as described in section 7. Take a density reading from the first image that is not covered with characters. This reading can be compared to readings recorded when the film was produced, if available, and to subsequent reinspections to determine if the density has deteriorated. This deterioration would provide a warning of other problems.

6.3.3 Microfiche. Select a microfiche and examine it in its entirety with the unaided eye, rotating the microfiche so that light reflects off the surface. Examine the reverse side of the microfiche. Some forms of deterioration can be detected at this initial stage. Place the microfiche on the illuminated light box emulsion (dull) side up and examine the upper left, lower left, upper right, lower right, and center frames with the aid of an eye loupe. Both sides of the microfiche should be examined for the defects described in section 7. Take density readings from the header or some other portion of the microfiche that is not covered by characters. This reading can be compared to readings recorded when the film was produced, if available, and to subsequent reinspections to determine if the density has deteriorated. This deterioration would provide a warning of other problems.

6.4 Inspection Reporting. The inspector will complete the inspection report form after which a subjective judgment is required to be made indicating the overall level of condition of the film using the following categories: (1) excellent, (2) acceptable, (3) fair, (4) poor, or (5) bad. These categories are classified in Table 1.

Table 1. Severity Classification Table

1. No deterioration detectable. Film in *excellent* condition.
2. Deterioration clearly visible, but confined to noninformational areas. Film in *acceptable* condition.
3. Deterioration well advanced into information areas, but general shape of characters is unchanged. Film in *fair* condition.
4. Deterioration has altered or obscured the shape and size of characters to the extent that individual characters cannot be identified with certainty out of context. Characters can be identified in context. Film in *poor* condition.
5. Deterioration has altered or obliterated the size and shape of characters so that they cannot be identified with certainty in context. This constitutes information loss. Film is in *bad* condition.

6.5 Data Collection. The most desirable kind of report may differ from organization to organization and the factors of interest may change as the inspection program progresses. It is recommended however that at least two reporting forms be used: one for the initial inspection of each unit of a defined lot or group and another which will summarize the findings of those inspections and should include recommendations for remedial action if that is indicated.

The following are considered to be minimum data requirements for the initial inspection of the individual units. (See Data Collection Form in Appendix C.)

(1) Name of organization. This will in all likelihood be included in the form design title. However, in the case of records centers or archives it will be necessary to include a section for the department or agency involved.

(2) Record series, group, or collection identification. For example, Canada Savings Bond Series 32 or World War II savings certificates, or Glove and Mail newspapers 1950-1970.

(3) Film identification. Sufficient information to retrieve the film again.

(4) Name of inspector and date of inspection.

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(5) Film format. For example, roll, jackets, aperture cards.

(6) Film carrier if not roll. For example, jacket and manufacturer, aperture card and manufacturer.

(7) Processed by. For example, in-house, vendor, unknown.

(8) Year produced. For example, 1966, 1970s, etc.

(9) Film type. For example, camera negative, duplicate negative, duplicate positive.

(10) Film base. For example, polyester, acetate.

(11) Film size and thickness. For example, 16 mm, 35 mm, other, thin, thick.

(12) Name of film manufacturer. For example, Agfa Gravert, Fuji, Kodak, etc.

(13) Film usage. For example, archival, working master, active file, etc.

(14) Film container. For example, cardboard box, plastic box, metal can, etc.

(15) Type of reel, spool, core. For example, plastic, metal.

(16) Environmental conditions. Describe heat and humidity ranges, impurities in the environment if known. (see ANSI PH1.43-1985.)

(17) Type of leader. For example, fogged, clear, or spliced.

(18) Type of trailer. For example, fogged, clear, or spliced.

(19) Density/resolution. For example, 5.6 line pairs, 1.02 density, etc.

(20) Number and type of splices. For example, tape, glue, heat, etc.

(21) Type of restrainer used to confine the film. For example, rubber band, tape, string, plastic clip, etc. (Note: Any or all of these restrainers may damage film. AIIM does not recommend their use.)

(22) Type of deterioriation. Mold, discoloration (silvering, yellowing, bluing, and mirroring), scratches, redox blemishes, separation of emulsion, evidence of adhesion, etc.

(23) Location of deterioriation. Leader, image area background, character area, first channel of jacket, upper left corner of aperture card, first ten feet, whole roll, trailer, etc.

(24) Severity of deterioriation. See Table 1.

(25) Remarks. For example, further sampling required, duplication required, examine all other microforms dated before 1965, examine all microfilms generated in the city of Manassas, etc.

(26) Overall Assessment of Physical Condition. (Include inspector's comments, if desired) — excellent, acceptable, etc. (See Data Analysis Form.)

6.6 Data Analysis. The Data Analysis Form should include the following information:

(1) Name of lot, group, or collection.

(2) Inspection dates, beginning to end.

(3) Name of inspector(s).

(4) Number of units in lot—rolls, cards, jackets, microfiche.

(5) Number of samples inspected.

(6) Percentage of microforms in sample affected by deterioration.

(7) Type(s) of deterioration detected.

(8) Severity of deterioration.

(9) Remedial action.

a. further inspection of this lot at this time only
b. change leader/trailer only at this time
c. recommendation for changes to storage facility or container or packaging
d. recommendation for copying
e. referral to professional restoration
f. recommendation for sulfiding 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.

Note: With respect to redox blemishes, it is not necessary to report the different types of spots as classified by the National Institute of Standards and Technology (NIST). These classifications were developed to provide a uniform reporting system to assist the original research into the causes and their prevention. Therefore, for the purposes of this document, it is significant to note that they exist and place more reliance on the severity of the blemishes in terms outlined in Table 1, as should be the case with any other form of deterioration in order to identify and assess the problem.

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7 Types of Defects

7.1 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. Defects resulting from initial processing are described in ANSI/AIIM MS23-1983.

7.2 Microbiological Growths. When photographic films are stored for any length of time in an atmosphere having a relative humidity generally above 60 percent, there is a tendency for fungus (often called mold 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 (70°F), and a relative humidity, above 60 percent, they become very active, multiplying rapidly and attack 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 printer's engraving process, and eventually caused chemical breakdown so that the gelatin becomes sticky and readily soluble in water (see Figures A1, A2, A3, and A4). 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 or cotton moistened with an approved film cleaning liquid such as trichloroethylene. Refer to manufacturer's warning when using trichloroethylene or other cleaning fluids. Some chemical treatments are being tested which may also retard their spread. Serious damage should be referred to professional photographic technicians.

7.3 Redox Blemishes. Redox blemishes, sometimes referred to as measles, microscopic spots or aging spots, are a phenomenon first reported in 1963. These spots are small, 15 microns to 150 microns in diameter, reddish or yellowish in color and may be circular, with a tiny nucleus at their center, or irregular in shape. They have been classified by NIST into six different types. (Photographs and a description of each type is included as Appendix B, Figures B1-B6 courtesy of the National Institute for Standards and Technology.)

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, sulfur dioxide, hydrogen sulfide, or others, that occur in industrial atmospheres. Peroxides may be present in some woods and may also be formed as a result of the aging 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 and have been observed on film produced by various manufacturers in the U.S.A., Canada, and abroad. 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 and in some cases may be observed as a silver sheen on the emulsion side with the unaided eye in ambient room light. (See Figures A5 and A6.) 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 color in each spot which is derived from the colloidal silver. (See Figures A7 and A8). In severe cases, the color 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 color.

7.4 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 thiosulfate (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 washing is 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

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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.

Previous research indicates that attempts should not be made to reduce the thiosulfate concentration to zero. Residual thiosulfate reacts with image silver to form additional silver sulfide giving a greater resistance to peroxide attack, a principle element in the formation of redox blemishes.

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.

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.

7.5 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. For some films this is not quite as good in all respects or under all conditions as is the case with cellulose ester-type bases. The extreme chemical inertness of this film base makes the problem of adhesion much more difficult. Of importance is the effect of very low relative humidities which cause the gelatin photographic and backing layers to contract and impose severe stresses on the gelatin adhesion. Cycling relative humidities from moderate to very low (below 30 percent) cause 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 humidities, 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 (70°F) and a relative humidity between 30 percent and 50 percent. (See ANSI PH1.43-1985.) It is essential that polyester base films for permanent records not only meet the requirements of this specification, but that they be stored under proper storage conditions.

7.6 Separation of the Emulsion from the Film Base. This defect usually occurs only on roll film and is the result of the base sticking or, in severe cases, gluing itself to the emulsion of the next convolution and consequently is sometimes referred to as "fused film" or as "blocking". It is usually caused by:

(1) Improperly dried film wound onto reels/spools and subsequently stored;

(2) Storage in an environment of very high humidity;

(3) The dried residue of microbiological growth. Separation usually occurs when untrained persons attempt to unwind severe cases. (See Figures A9 and A10).

NOTE: Separation of the emulsion from the film base may also occur during initial processing and is referred to as frilling see ANSI/AIIM MS23-1983.

7.7 Brittleness. Brittleness is the absence or loss of natural moisture resulting in a tendency to break or crack easily when bent. It is usually caused by very warm and dry storage conditions. Often the film can be reconditioned by placing the film in an environment of 45 percent to 50 percent relative humidity for 48 hours. Severe cases may require 5 to 10 days to restore proper moisture content.

7.8 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. It is important not to fold the film or it may break.

8 Remedial Action

8.1 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 archivally will need no remedial action and may not need as frequent or as extensive reinspections as film that exhibits deterioration in the first inspection or is not stored archivally. In either case, subsequent inspections should include some reels previously inspected to determine if the condition of the film has shown additional deterioration and 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 being tested which may also retard their spread. Minor forms of deterioration on film rated as fair may be corrected with approved cleaning materials such as trichloroethylene, although duplication is recommended. Refer to manufacturers' warnings when using cleaning materials. Information loss

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cannot be restored on film rated as bad. An inspection should be made immediately of all film with similar characteristics as the film rated as fair, poor, or bad. Poor and bad film should be duplicated immediately in order to salvage the remaining information.

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. An evaluation of the storage facility and packing containers should be made and film transferred to archival storage facilities and packing containers as soon as possible. Any corrective action should be implemented immediately.

8.2 Subsequent Reinspections. The condition of the survey group will determine subsequent actions and reinspections. For example, survey groups that have exhibited no forms of deterioration and are stored under ideal conditions may not need to be reinspected 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.

Subsequent reinspections should include a random sample of microforms generated since the last inspection, samples previously inspected from older lots, as well as other microforms not previously selected. The following is offered as an example: A survey group had 5,000 microforms at the time of the first inspection and 100 were inspected. Since that time, 500 new microforms have been added to the survey group. The subsequent inspection should include two from the previous 100 inspected, 88 from the previous 4,900 not inspected and 10 from the 500 new ones.

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Appendix A. Examples of Film Defects

(This appendix is not part of American National Standard for Information and Image Management—Recommended Practice for Inspection of Stored Silver Gelatin Microforms for Evidence of Deterioration, ANSI/AIIM MS45-1990)
NOTE: These figures appear on the enclosed microfiche.

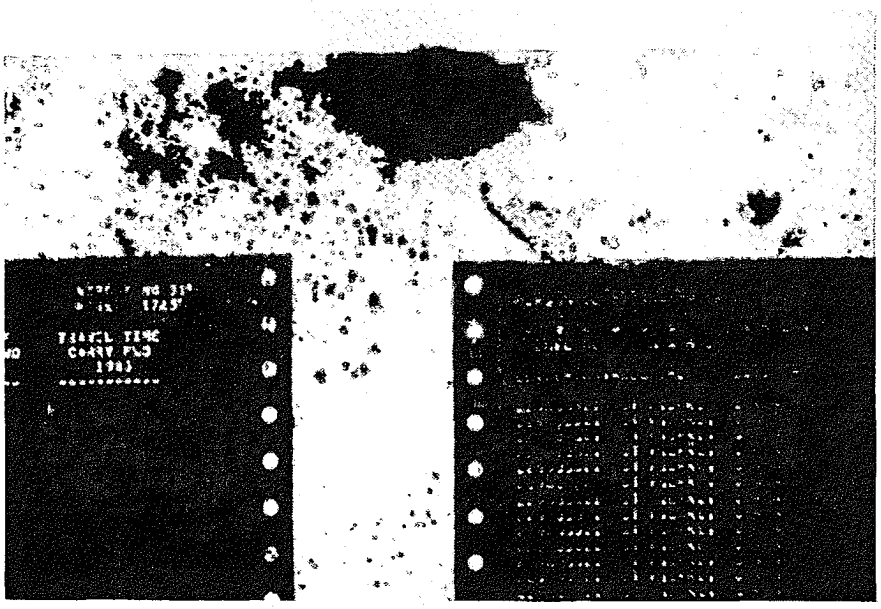

Figure A1. Fungus actively growing.

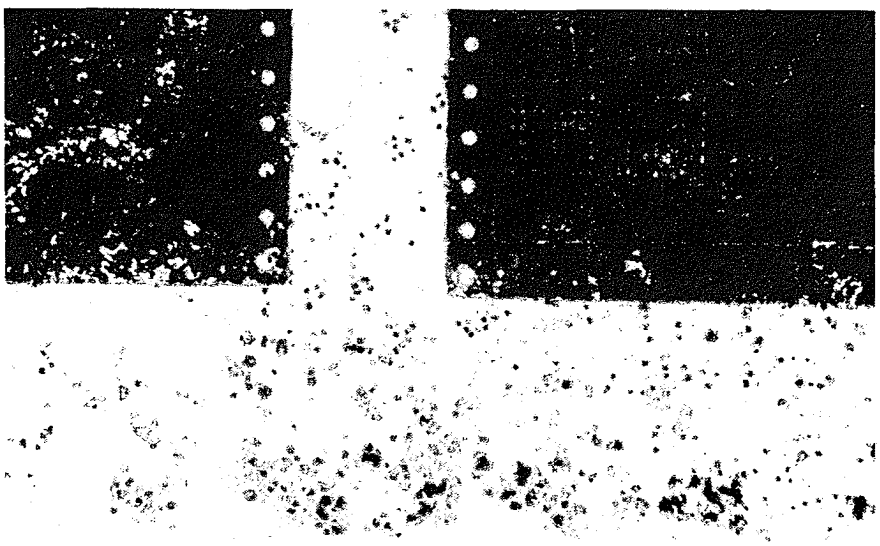

Figure A2. Fungus beginning to destroy the emulsion.

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Figure A3. An extreme case of destruction showing the solubility of the emulsion.

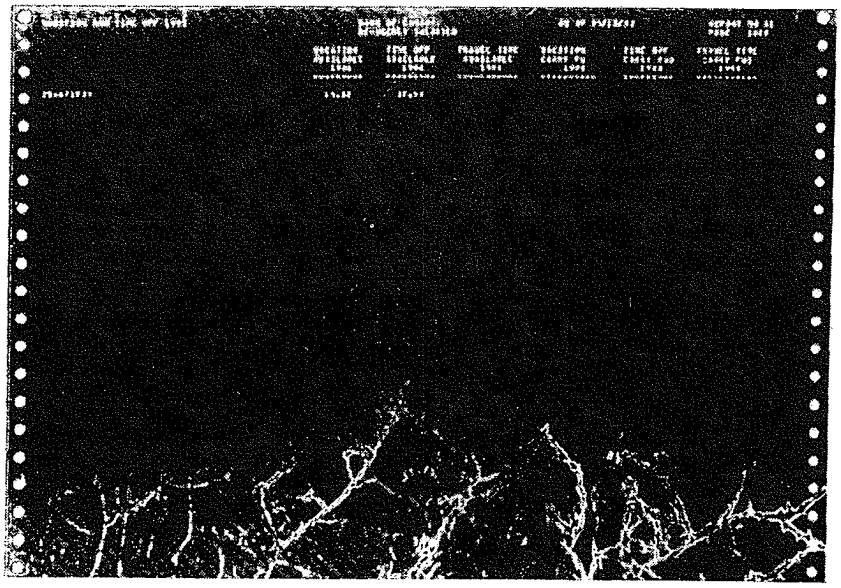

Figure A4. Etching action of the fungus after clean up.

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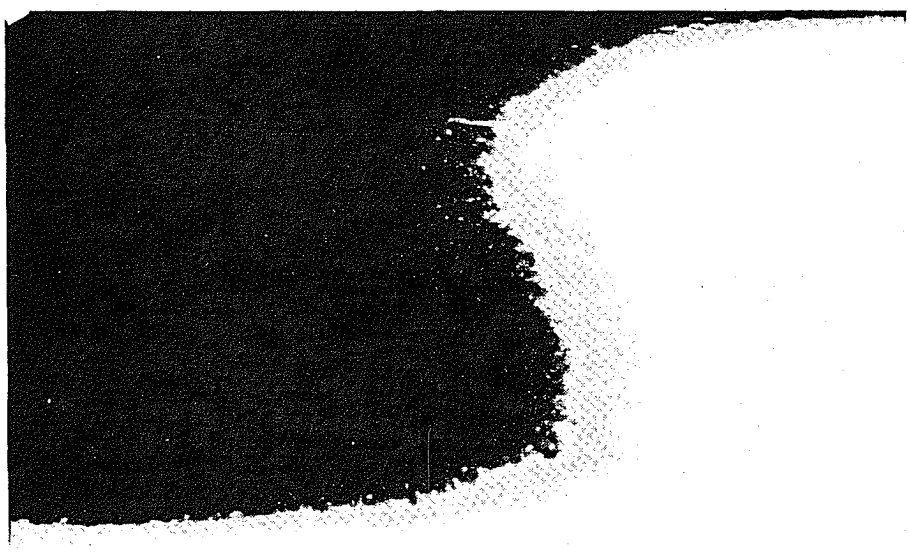

Figure A5. Exposed leader where D-max shades to D-min long colored streak is evidence of scratches.

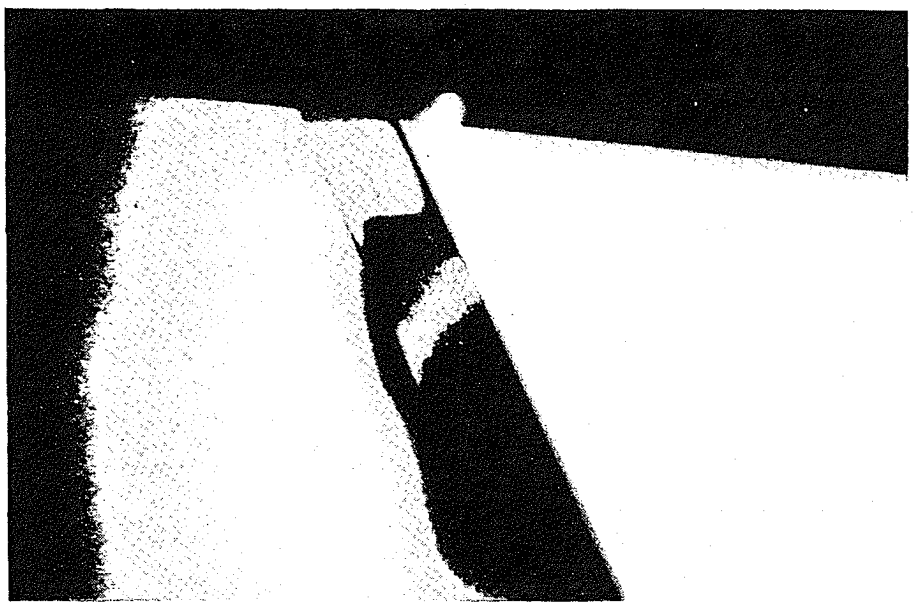

Figure A6. Silver sheen is shown on fogged leader in ambient room light without magnification.

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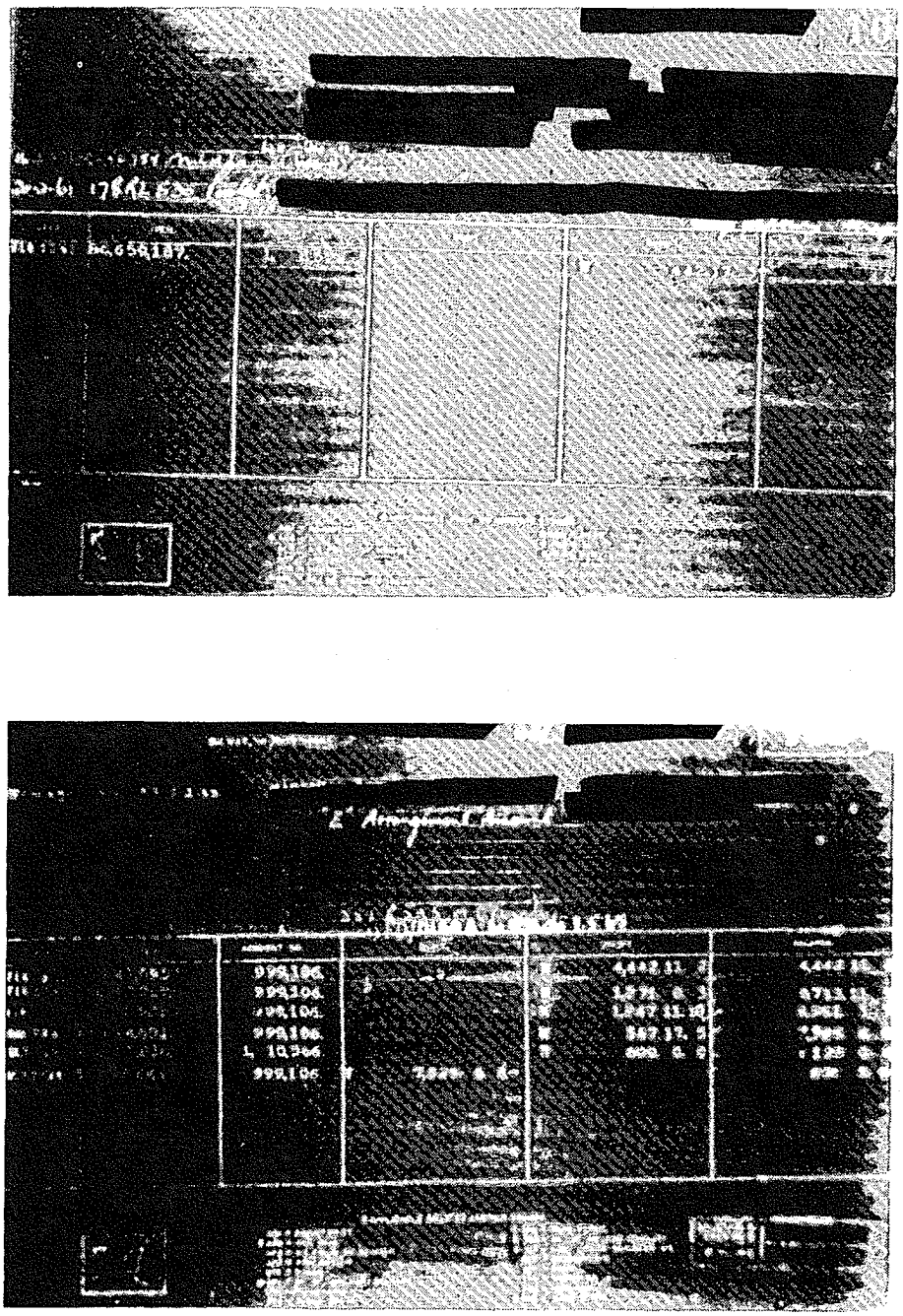

Figure A7. Colored spots are easily discernible in the lines, characters, and background areas. The fact that different sizes of spots are also clearly visible may indicate that there is a definite growth pattern.

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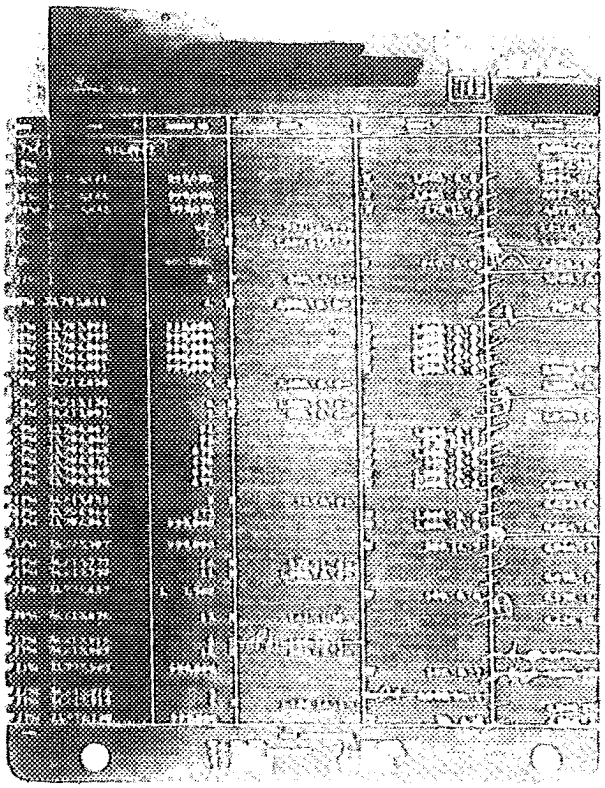

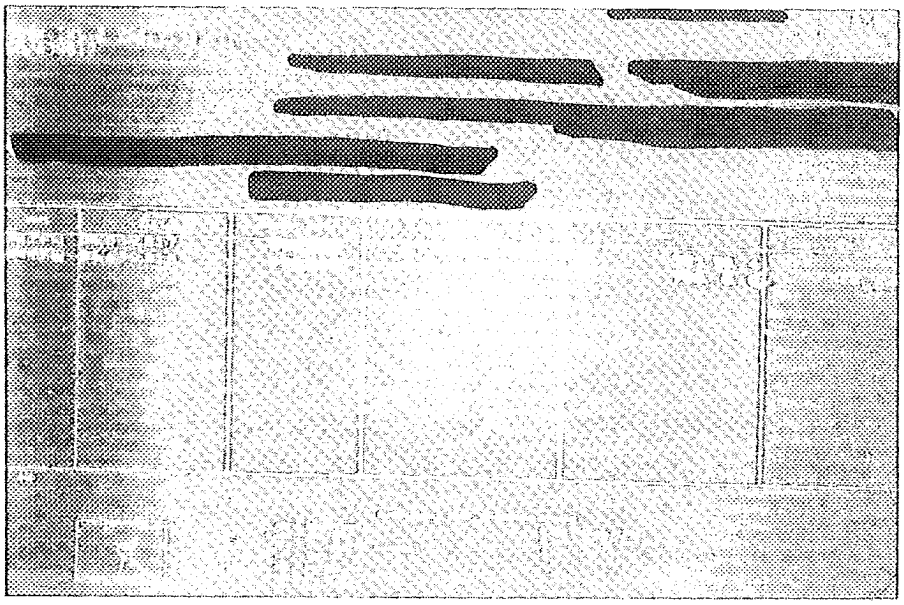

Figure A8. While under severe attack, the text is still legible at this state. The center nuclei is visible in those spots in the background only. It is difficult to discern whether or not the spots in the lines are Type 2 or another type.

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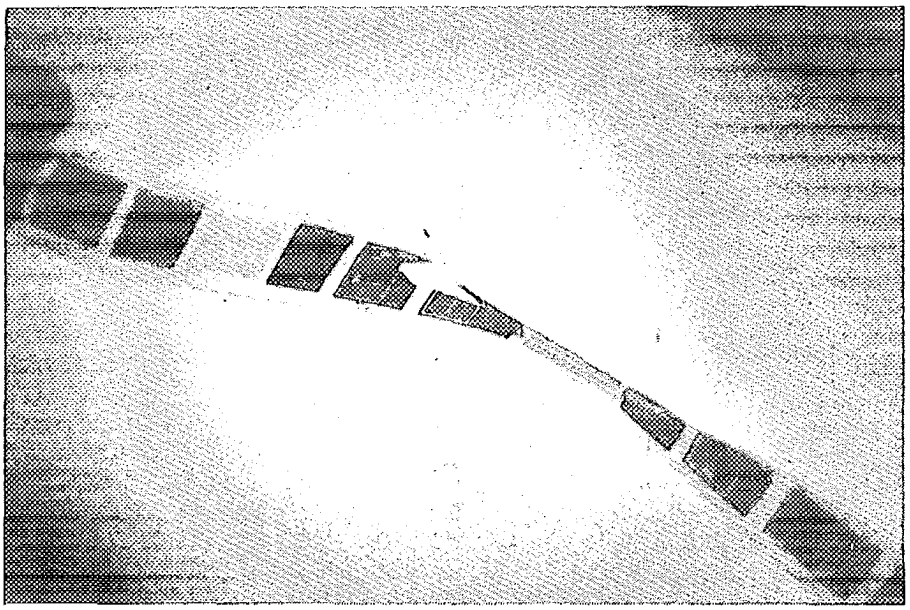

Figure A9. Separation of the emulsion from its base is clearly visible.

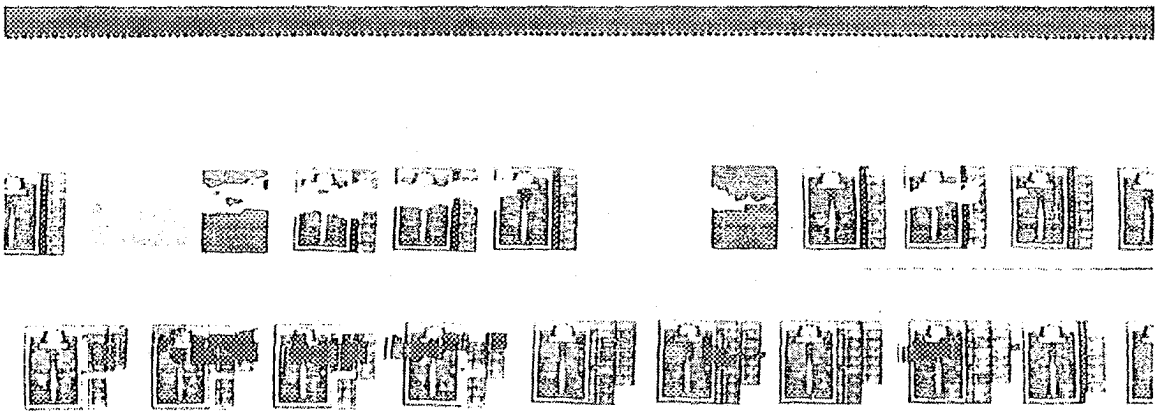

Figure A10. The emulsion from the top strip of 16 mm film has been ripped off its base in an ill-advised attempt to unwind the film from its lower strip. It can be seen fused to the lower strip as represented by the dark areas.

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Appendix B. Description of Redox Blemishes

(This appendix is not part of American National Standard for Information and Image Management—Recommended Practice for Inspection of Stored Microfilm, ANSI/AIIM MS45-1990)
NOTE: These figures appear in color on the enclosed microfiche.

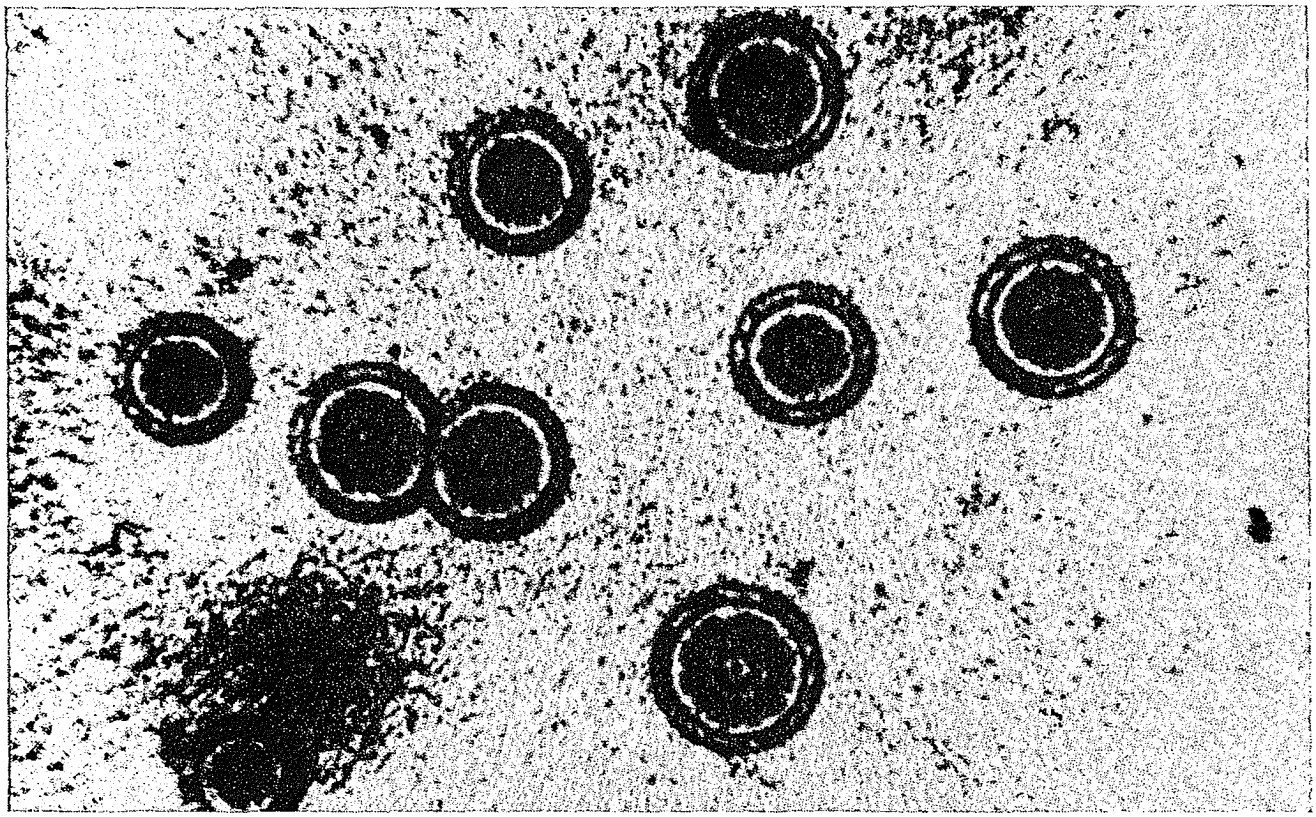

Figure B1. Aging blemishes are circular spots usually 50 to 150 microns in diameter with sharp boundaries. Concentric light and dark rings are common. Spots normally occur as reduced density in high-density "background" areas, but may make incursions into low-density lines or characters. They are usually brown, orange, reddish, or yellow in color. It is common to find many spots about the same size on a sample. The circular boundaries of two or more spots may intersect. The spots are often centered on scratches in the emulsion, sometimes closely packed like beads on a string. They sometimes occur in higher concentrations at steep density gradients between high- and low-density regions, sometimes being so closely packed as to give the appearance of a continuous band. By reflected light, the spots may display a silvery sheen. (Blemishes in this enlargement range from 120 microns to 170 microns in diameter.)

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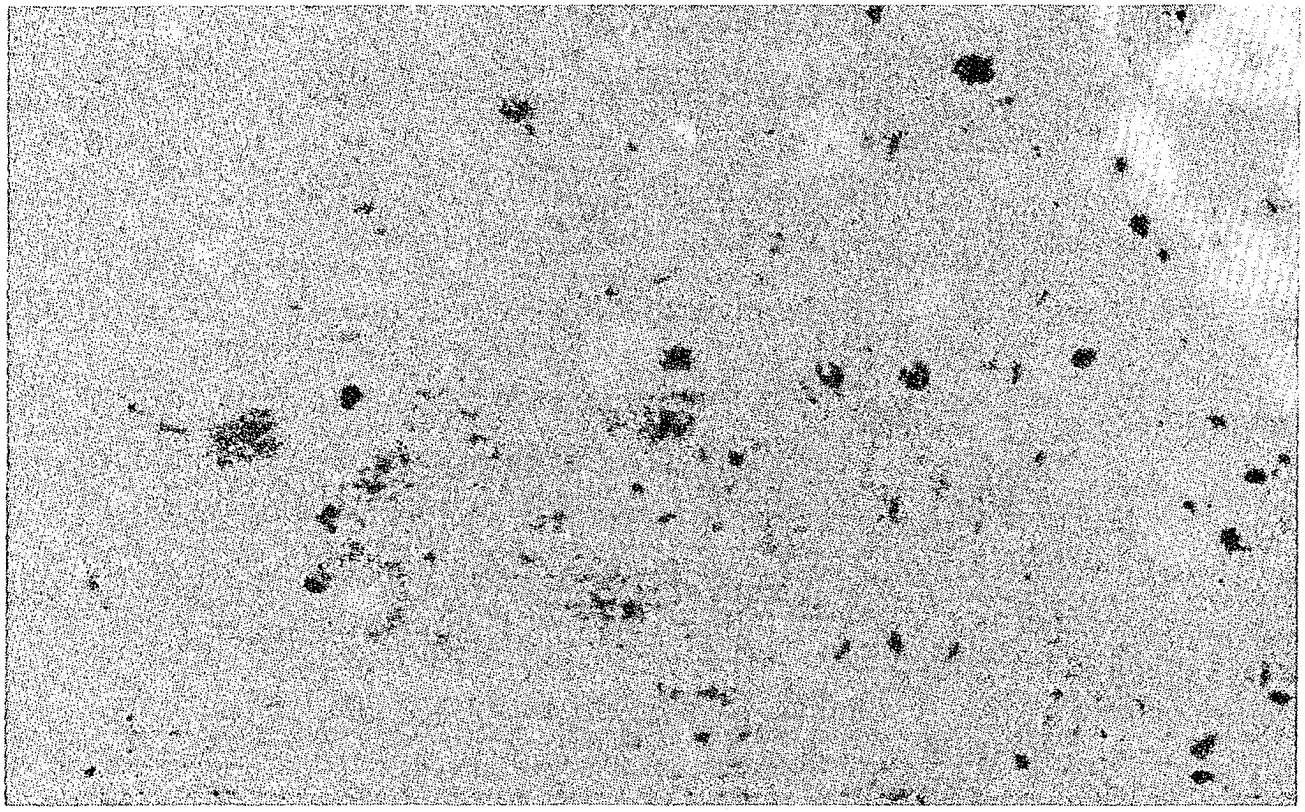

Figure B2. This figure shows defects in the light lines forming the characters themselves, rather than in the high-density "background." The lines making up the characters become lighter, yellowish, and broader. The boundaries of the defect are sharp. (The height of the numbers in this figure is 180 microns.)

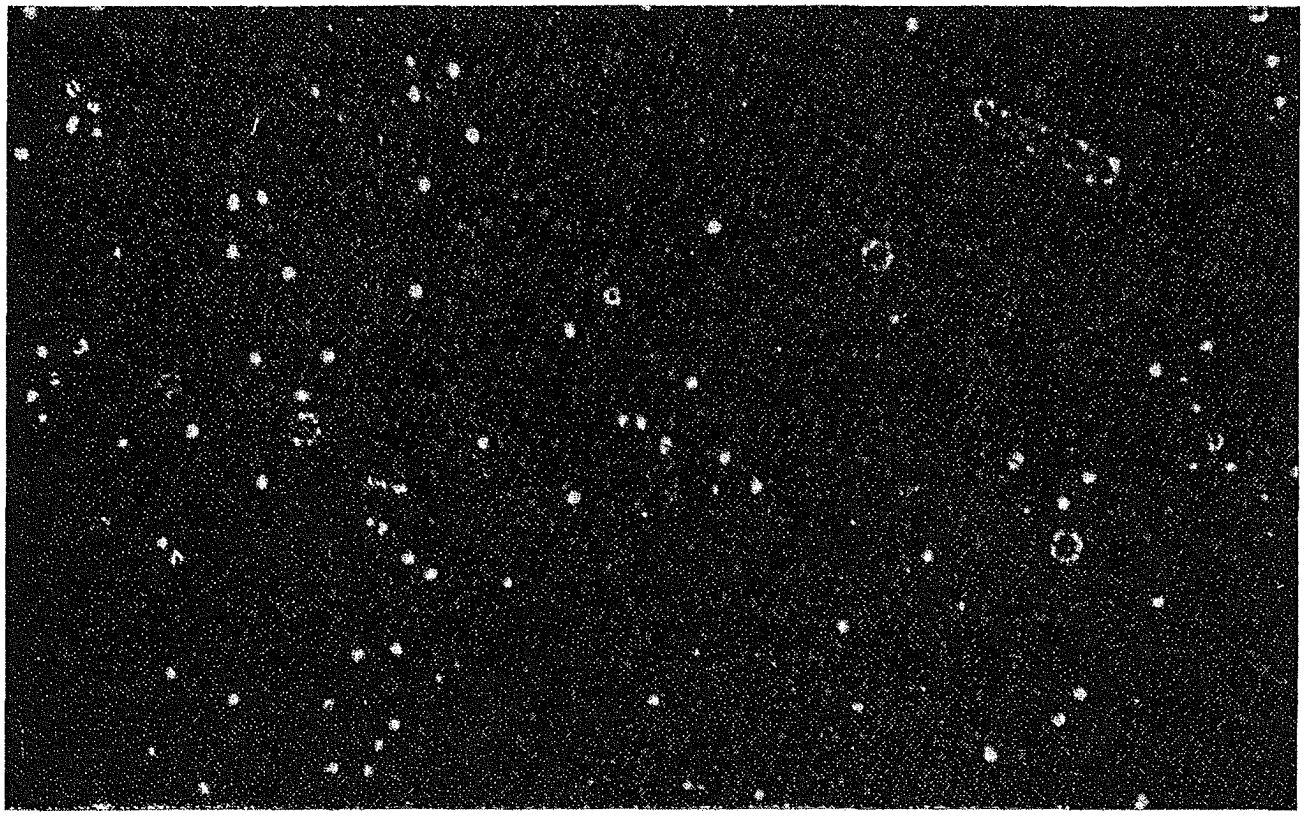

Figure B3. Shown are very small spots, about 10 microns to 15 microns across. When they occur, there is usually a large number per unit of area. They usually range from pale yellow to orange in color. Their boundaries are sharp. By reflected light, the spots may display a silvery sheen. (Blemishes in this enlargement are approximately 15 microns in diameter.)

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Figure B4. In this figure blemishes are spots of less regular shape than in Figure B1, but about the same size or a little larger, usually lighter in color and less sharply bounded. A circular central "nucleus" is common. These spots occur in high-density "background" areas. They do not make incursions on low-density characters; on the contrary, their shapes may be very distorted to accommodate to the spaces between characters or parts of characters. (The height of the numbers in this figure is 240 microns.)

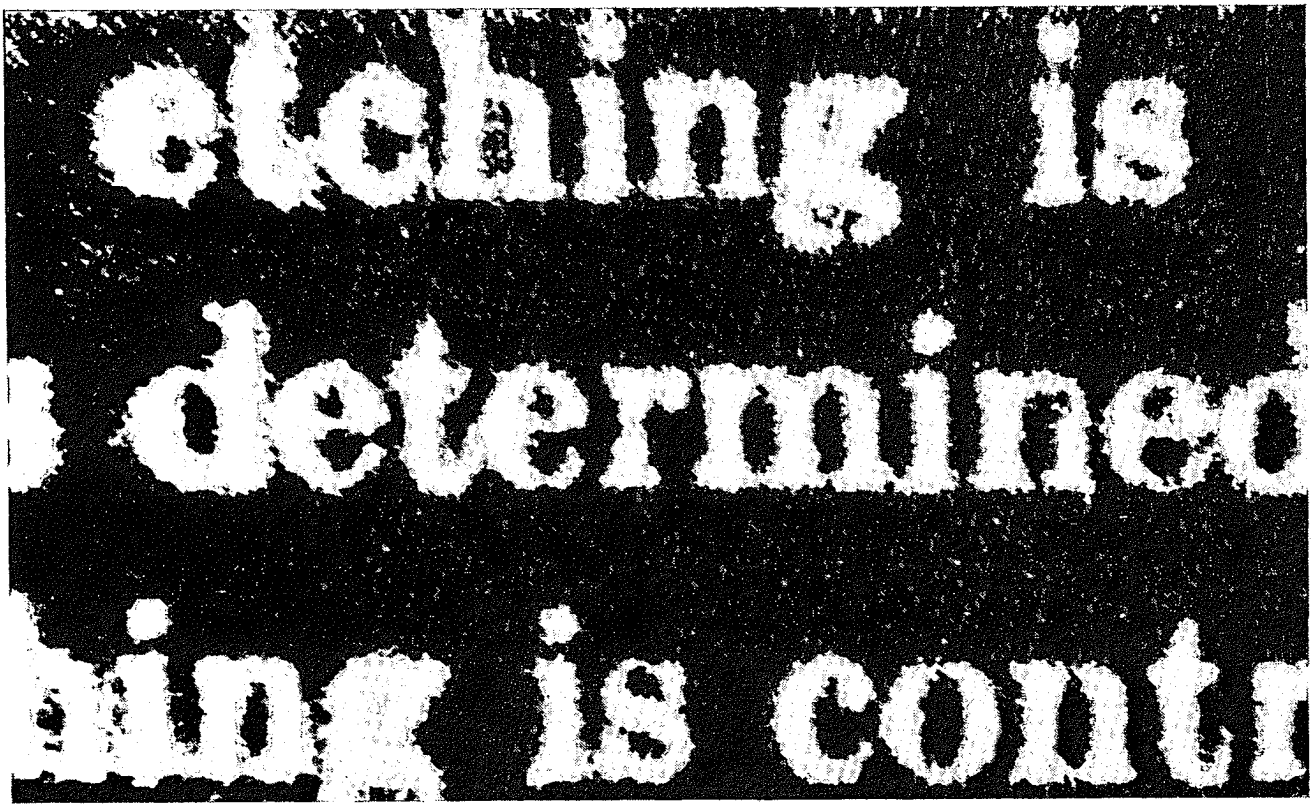

Figure B5. This figure shows a reddening of the dark background in the immediate neighborhood of lighter characters. The boundaries of the discoloration are very diffuse. The shape is not regular, being determined by the shape of the characters or line of characters with which the discoloration is associated. (The height of the lower case letters in the enlargement is 120 microns.)

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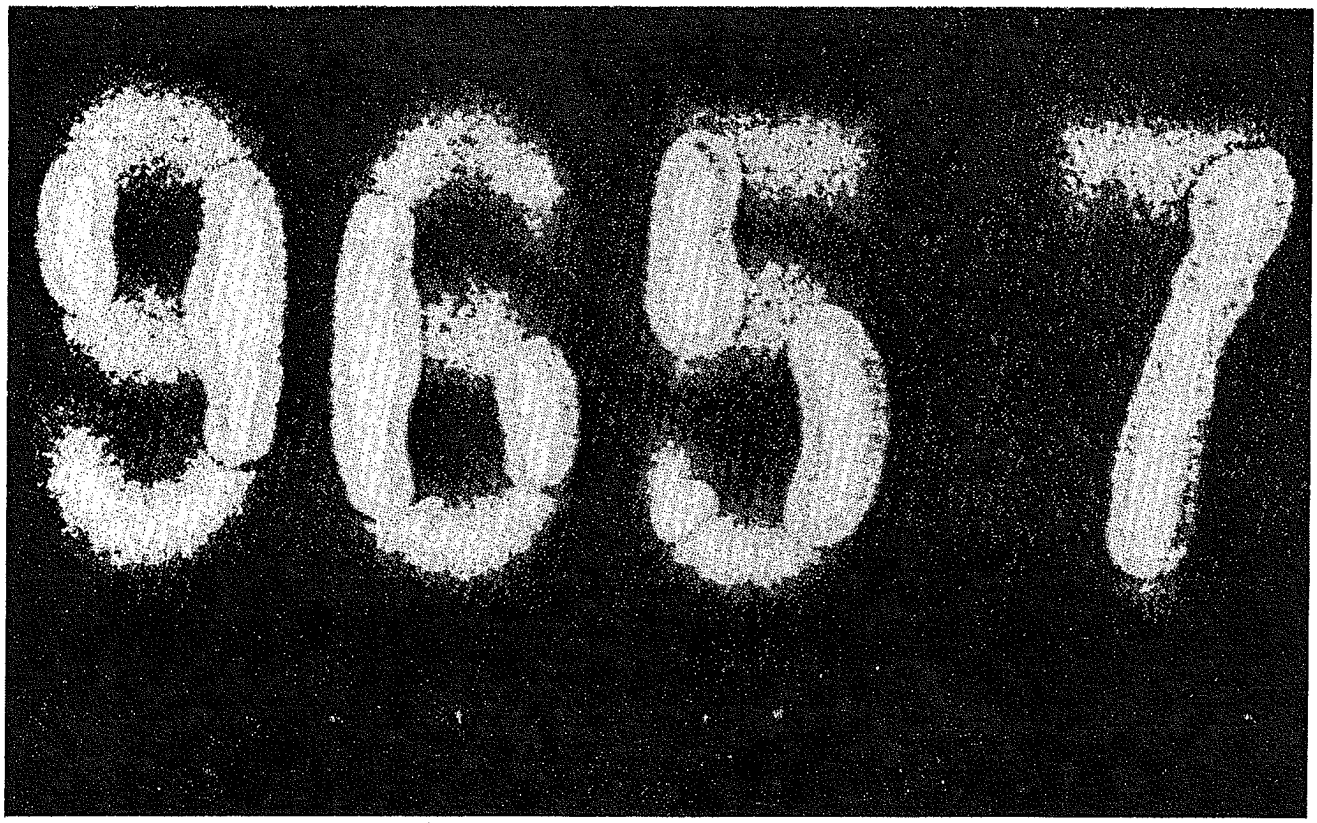

Figure B6. Shown is a reddish, orange, or yellow spot of reduced density, lightest at the center and gradually blending into the surrounding background. An irregular opaque or crystalline particle is commonly observed on the surface of the film at the center of the spot. The sizes of the spots may vary considerably, even within a small region. (Blemishes enlarged in this figure range from 30 microns to 110 microns in diameter.)

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Appendix C. Data Collection Form

(This appendix is not part of American National Standard for Information and Image Management—Recommended Practice for Inspection of Stored Silver Gelatin Microforms for Evidence of Deterioration, ANSI/AIIM MS45-1990)

DATA COLLECTION FORM

I. Film Identification

1. Name of Organization _____
2. Record Series _____
3. Film Identification: Roll or I.D. No. _____
   Location _____
4. Name of Inspector _____ Date of Inspection _____

II. Description of Microform, Storage and Use

5. Film Format
   - ☐ Roll
   - ☐ Jacket
   - ☐ Aperture Card
   - ☐ Microfiche

6. Film Carrier type
   _____
   Manufacturer
   _____

7. Processed By
   - ☐ Inhouse
   - ☐ Vendor
   - ☐ Unknown

8. Year Produced _____

9. Film Type
   - ☐ CN ☐ DN ☐ DP

10. Film Base
    - ☐ Acetate ☐ Unknown
    - ☐ Polyester

11. Film Size
    - ☐ 16 mm ☐ Thick
    - ☐ 35 mm ☐ Thin
    - ☐ 105 mm
    - ☐ Other

12. Name of Film Manufacturer
    _____

13. Film Usage
    - ☐ Archival/Camera Master
    - ☐ Working Master
    - ☐ Use Copy

14. Film Container
    - ☐ Cardboard Box
    - ☐ Plastic Box
    - ☐ Metal Can
    - ☐ Paper Envelope
    - ☐ Tyvek Envelope
    - ☐ Other _____

15. Reel Type
    - ☐ Plastic
    - ☐ Metal

16. Environmental Conditions
    Temp. _____
    R.H. _____
    Impurities _____

17. Type of Leader
    - ☐ Fogged
    - ☐ Clear
    - ☐ Both
    - ☐ Spliced

    more than one may be checked

18. Type of Trailer
    - ☐ Fogged
    - ☐ Clear
    - ☐ Both
    - ☐ Spliced

    more than one may be checked

19. Density _____
    Resolution _____
    First Reading? ☐ Y ☐ N
    Compared to previous readings, this reading is ☐ Same ☐ Lower

20. Type of Splice
    - ☐ Glue ☐ Tape
    - ☐ Ultrasonic ☐ Other
    - ☐ Heat

    Number of Splices
    - ☐ None ☐ 11 or more
    - ☐ 1-5
    - ☐ 6-10

21. Type of retainer used to confine film
    _____
    _____

III. Inspection Data/Deterioration Identified

22. Type/Deterioration
    - ☐ Mold/Fungus
    - ☐ Excessive Brittleness
    - ☐ Discoloration
    - ☐ Scratches
    - ☐ Water Spots/Streaks
    - ☐ Dirt
    - ☐ Evidence of Adhesion
    - ☐ Poor Film Splices
    - ☐ Separation of Emulsion
    - ☐ Chemical Stains
    - ☐ Unusual Odors
    - ☐ Torn or Nicked Film
    - ☐ Redox Blemishes
    - ☐ Other

23. Location _____

24. Severity _____

25. Remarks: _____

26. Overall Condition of Film
    - ☐ Excellent ☐ Acceptable ☐ Fair ☐ Poor ☐ Bad

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Appendix D. Data Analysis Form

(This appendix is not part of American National Standard for Information and Image Management—Recommended Practice for Inspection of Stored Silver Gelatin Microforms for Evidence of Deterioration, ANSI/AIIM MS45-1990)

1. Name of lot _____

2. Inspection dates _____

3. Name of inspectors _____ _____

_____ _____

4. Number of units in lot _____

5. Number of samples inspected _____

6. Percentage of rolls in sample affected by deterioration _____

7. Types of deterioration detected _____

_____

_____

_____

_____

8. Severity of deterioration _____

_____

_____

_____

_____

9. Remedial action _____

_____

_____

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