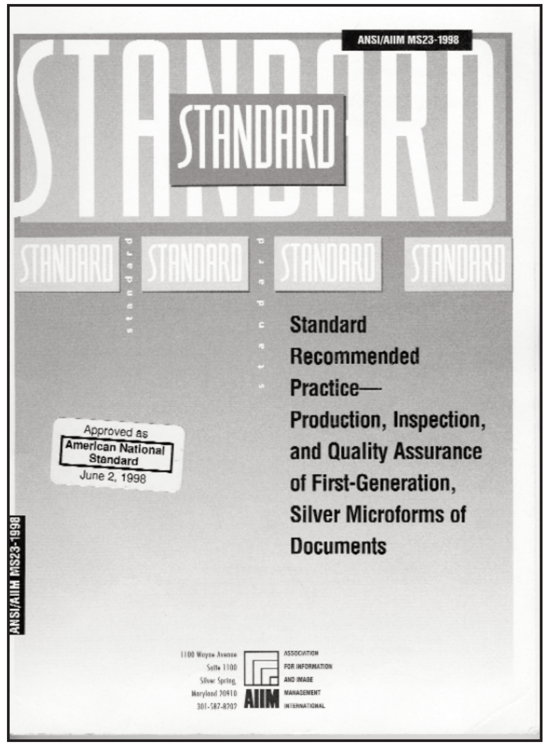
Section 1: Purpose



The purpose of this manual is to give an overview of the operations and equipment of a microfilming program, to outline and reference the microfilming standards and policies of Oregon Administrative Rules (OAR) 166-025-0005 through 166-025-0030, the American National Standards Institute (ANSI), and the Association for Information and Image Management (AIIM). It also serves to offer appendices of sample forms and instructions. Following this manual will help you to better understand the microfilming process, produce high quality microfilm that meets or exceeds its life expectancy, and have your microfilm successfully accepted by the Security Copy Depository at The Oregon State Archives.

Throughout this manual quality procedures and controls are identified by referring to ANSI/AIIM standards, guidelines, and specifications. They provide the basis for all microfilm operations and must be adhered to. They are best followed by using this manual in conjunction with *ANSI/AIIM MS23 1998 Standard Recommended Practice – Production, Inspection, and Quality Assurance of First-Generation, Silver Microforms of Documents.* A complete listing of the titles for ANSI/AIIM Standards can be found in Appendix __ of this manual.

Section 2: Overview of a Microfilm Program

2.1 Is Microfilm Still Necessary?

Yes. Today, the life cycle of documents is managed most successfully by creating a "hybrid" information system that combines microfilm with digital technologies. Microfilm works within these systems to assure the integrity and long-term storage of the electronic records.

Electronic systems are the fastest way to retrieve and distribute your records, but because their software and the systems themselves change so rapidly they are not reliable for the long-term storage (at least one hundred years) of records. Microfilm is the only medium that can assure the retention of information for the next 500 years. Access to information on microfilm is guaranteed, since all you need to view it is a light source and a magnifying glass. Microfilm is a perfect medium for transferring, or *migrating*, information to new systems and technologies since it can be scanned into any digital system. Microfilm also protects your records from being altered or lost, while computer hackers continue to prove that electronic records are never truly secure. Microfilm is a cost-effective alternative to paper in terms of access, duplication, and storage.

There are, naturally, some disadvantages to microfilming. Delays, mechanical breakdown, quality control problems, and the volatility of the medium itself are problems that you may encounter if you use microfilm for records storage and retrieval. Vendor portrayals of micrographic systems and their possibilities have been at times, overly simplistic and misleading. Consequently, expectations of microfilm have sometimes been unrealistic. A prudent examination of your records and what microfilm can do for them may lead to a decision not to microfilm.

2.2 Needs Assessment

Does microfilm meet your agency's needs? Analyzing your records and the workflow within your agency is the first step towards determining if microfilming is right for you.

Assess the following conditions of your records and office workflow to determine your need for a microfilm system.

Retention and Storage
A record's retention period is the most important factor for you to consider in deciding whether it should be microfilmed. Make sure you know the retention schedule of each record series you are working with. Oregon public records with a retention period of a hundred years or longer are required to be kept as originals or reformatted onto security microfilm *(See OAR 166-030-0070(1))*. Generally, microfilming is considered a cost-effective format for retaining records with a retention period of at least fifteen years.

The shorter the retention period of a record the less cost-effective microfilming will be if you are considering microfilm solely as a space-saving alternative. Storing non-active paper records, with a retention period of less than ten years at the State Records Center is much more cost-effective than using office space to store them.

If you have any questions about storing your paper records at the State Records Center, call the Archives Division at 503-373-0701.

Volume and Usage
If you are considering microfilming a particular record series because of its large volume you must also factor in its usage rate and

retention period. If the usage rate is low and the retention period is short it is probably not worth the time and money to microfilm these records. If the usage rate is high, factor in the length of the retention period and consider who uses the records. How would access be improved if they were on microfilm?

Physical Characteristics and Preparation
If records are disorganized or in poor condition, preparing them for filming may be the most expensive part of your microfilming program. The size, shape, color and legibility of the records will also determine how easily they can be prepared for filming and sometimes if they can be filmed at all. *(Note: See ANSI/AIIM MS35-1990 Recommended Practice for the Requirements and Characteristics of Original Documents That May Be Microfilmed.)*

2.3 Cost Analysis

Whether you are planning an in-house microfilm program, or out-sourcing certain operations to a service bureau, a cost analysis must be conducted. The following elements must be considered while evaluating costs.

Labor
How will microfilming your records change the way your employees work? How much time will be spent preparing and/or microfilming records? Will microfilming records cause delays in accessing, retrieving or refiling records, especially by more than one person at a time?

Start-up Costs
The initial costs of starting a microfilm program are substantial. Determine which operations, if any, should be out-sourced and solicit bids from several companies. Costs are usually calculated on a per image basis.
Remember that the Request for Proposals (RFP) must include detailed specifications, performance standards, and penalties for non-compliance. Depending on the scope of your in-house operation you will need to research the costs of cameras, processing and lab equipment, editing devices, and installation charges.

Maintenance
Maintenance costs are associated with the use of all micrographic equipment. The anticipated annual cost of maintaining a piece of equipment is generally considered to be between ten and fifteen percent of its purchase price. The annual cost of rented equipment may be between one-half and one-third of the purchase price. Maintenance is usually included in the rental agreement.

Materials and Supplies
The supplies and materials needed for a micrographics program will include:

Document preparation: paper, pens, staple removers, scissors, tape.

Filming: microfilm, targets, reels, film boxes, counter, overhead lamps, exposure meter, voltage control device, voltage readout device, production log, camera brushes, cleaning supplies, black cloth or paper.

Processing: chemicals, microscope, control strips, sensitometer.

Quality Control: gloves, light-boxes, eye loupes, magnifying devices, reader, tracking logs, densitometer, splicers and splicing tape, film length measurer, film rewinders, storage boxes, labels.

Note: See Section 3: Equipment & Supplies of this manual and Section 6 of MS23-1998 Standard Recommended Practice – Production, Inspection, and Quality

Assurance of First-Generation, Silver Microforms of Documents

Personnel
To operate and maintain micrographic equipment, the hiring and training of additional staff must be considered. Technical positions such as camera operators, processing technicians and quality control editors might be needed. Non-technical positions for routing and preparing materials might also be needed. A program manager and technical supervisors are other staffing considerations.

Work Space and Renovations
A microfilm program needs space for staff and equipment. There are also structural requirements to be considered for camera areas, processors, darkrooms, sinks, etc. You will need to calculate the cost of the space needed and any necessary renovations.

2.4 Service Bureaus

Service bureaus offer services for every level of microfilm production and storage. While planning your microfilm program consider the following pros and cons of using a service bureau.

Pros

Expertise
Service bureaus may possess a higher level of expertise than a government agency whose mission is not microfilm.

Personnel
It is not always easy or feasible to dedicate personnel to a microfilm program.

Cost
In many instances, the cost savings realized by operating an in-house program are very slight.

Equipment Availability
Most vendors have a wide range of micrographic equipment and technology at their disposal. This allows them to tailor each application to the particular need of their client.

Space Savings
It takes considerable office space to properly equip a microfilm program. The special requirements of camera and processor set-up do not always integrate easily into the standard office environment.

Cons

Quality Control
The agency, not the service bureau, is ultimately responsible for the quality of the microfilm. All microfilm produced by a service bureau must be carefully checked for both technical and informational defects.
Note: Agencies submitting film to the Security Copy Depository (SCD) are responsible for all the work performed by the vendor. The Agency should use the Microfilm Inspection Form (a copy is in the appendix) to ensure that all microfilm produced by the service bureau meets the technical standards of OAR 166-025-0015. Microfilm that does not meet these standards will not be accepted by the SCD and will be returned to the Agency.

Before selecting a vendor please call the Archives Division at 503-373-0701, ext. 255, to learn more about the quality standards vendors must meet when their work is inspected by the agency and the Archives Division.

Removal of Records
Each time records are removed from the agency they run the risk of being lost or damaged. Access to these records may also be lost when they are relocated for filming.

A specified time period for records to leave the agency must be set and a system for tracking them must be implemented. The service bureau must be able to provide a secure area for the records to protect them from theft or disaster.

Disagreements

How will disagreements be resolved between the agency and the service bureau, especially those involving the quality of the microfilm?

Any contracts made between the agency and the service bureau must specify that the microfilm produced will meet the technical standards of OAR 166-025-0015. If inspection of the microfilm, by the agency or the Archives, shows that these standards are not met provisions must be in place to ensure that the records are refilmed.

2.5 Deciding to Microfilm: A Checklist

How will microfilm affect the workflow of the agency?

How often are these records used and who uses them?

How will access to these records be improved by microfilm?

Will microfilming records cause delays in accessing, retrieving, or refiling records, especially by more than one person at a time?

How will microfilming records affect the public's access to them?

What is the retention period of the records? *The State Archives recommends that only records with a retention period of at least fifteen years be microfilmed. Consider storing records with retention periods under fifteen years at the State Records center.*

Is the condition of any records too poor for them to be filmed?

Will the shape, size, or color of the records make it difficult for them to be filmed?

How long will it take to prepare and organize the records for filming? *Remember, if records are disorganized or in poor condition preparing them for filming may become the most expensive part of the microfilm program.*

How will a microfilm program change the personnel needs of the agency?

How many new positions will need to be filled?

How much training will employees need to receive on technical and non-technical microfilm operations?

Can the microfilm be used to ensure the long-term storage and integrity of electronic records?

What operations of a microfilm program can be performed in-house and which will be outsourced to service bureaus?

Will any building renovations need to be made in order to accommodate a microfilm operation?

2.6 System Selection

In order to design a successful microfilming system you will need to consider the overall purpose of your program, the technical specifications the microfilm will need to meet for its intended usage, and the storage and retrieval needs of your agency and other users.

2.6.1 Reasons for Filming

Your decision to microfilm your records might depend on one or more of the following reasons. Use the purpose of your program to outline the design of your system.

Information Preservation
Ensuring long-term access to records is often a main reason for beginning a microfilm program. To meet these needs microfilm must consistently meet the ANSI/AIIM standards for production, processing, quality control and storage.

A system designed for the preservation of long-term records must include the following components.

Microfilm with a *Life Expectancy (LE)* rating that supports long-term storage. Most microfilm has a LE rating of 100 or 500 years.

A processor and processing staff capable of producing microfilm that is free of residues and defects that could lead to deterioration.

A quality control staff that can identify and remove flawed film before it is stored.

A storage facility that can be monitored to ensure the proper environmental conditions for long-term storage, and a staff that can provide the necessary quality control inspections throughout the lifetime of the microfilm.

Ready Access to Information
How quickly will you need to access information stored on microfilm? Information stored on microfilm can never be retrieved as quickly as information stored on an electronic system. However, there are microfilm systems which use a computer to index and access records. These systems are called Computer Assisted Retrieval (CAR) systems and they are capable of finding a microfilmed record much faster than if you were looking for it manually.

If you decide to invest in a CAR system you will have to prepare your documents for a computer index that will allow the CAR system to access them. In CAR systems, documents must be numbered and a level of rectangular marks called *image marks* or *blips* must be determined in order to count the pages automatically.

Duplication of Documents
The output devices (*readers* and *reader-printers*) of your system will need a high resolving power or resolution in order to reproduce sharp paper copies. The higher the resolving power of these devices is the better the paper copies will be. Also, consider the size of the documents being reproduced and their volume when evaluating the capabilities of your output devices.

Distribution of Documents
In order to distribute *duplicate* reels of microfilm you must ensure that your system produces an *original* or *master copy* that meets the standards of the Archives Division *(See OAR 166-025-0015)*. You must also be sure that the format (16mm or 35mm) of the film you are producing can be used on the microfilm readers and reader/printers of the end-users.

Source for Image Digitization
Systems that produce microfilm as a source for image digitization must ensure that the microfilm meets certain specifications in order for the information to be digitized successfully. Consider factors such as image position, reduction ratio, and contrast when determining the compatibility of the microfilm with a digital imaging system.

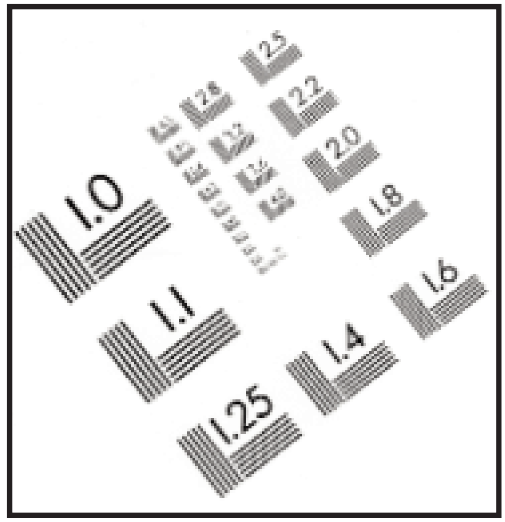
Maintain File Integrity
Records that are microfilmed in order to maintain file integrity for legal reasons must be filmed in accordance with established procedures and standards in order to be admissible as evidence. Factors such as custodianship of the records, the proper informational targets, and the splicing of retakes must be considered. *Note: See ANSI/AIIM TR100 Legal Admissibility Standards.*

Reduce Storage Requirements
No matter what size film you use the storage requirements of your documents will be greatly reduced by putting them on microfilm. Never choose 16mm film over 35mm film only because it takes up less storage space. Only minimum consideration should be given to film size as a means of storage reduction and it should only be given after evaluating the needs of your end-users and other necessary system capabilities.

End-use Factors
The technical specifications of the microfilm you produce will depend largely on how you plan to use it. Consider the following factors while designing your system, so that the microfilm you produce meets the needs of the end-user.

Resolving Power
The overall readability of the microfilm produced on your system is determined by its *resolving power* or *resolution*. Resolving power is largely determined by the ability of your camera lens to capture the closely spaced objects in a photographic image and make them recognizable as a single object. Other factors which will affect resolving power are the condition of the documents you are filming, the resolution considerations of the film, and the quality of your processing. *Note: See ANSI/AIIM TR26-1993 Resolution As It Relates to Photographic & Electronic Imaging.*

Density Uniformity
The level of light absorbed by microfilm must be constant throughout the reel in order to provide quality duplicates. This is known as *density uniformity*. Density levels are determined by the contrast between the text and the background in a document. Maintaining the same level of density in documents of varying contrast is achieved by adjusting the amount of light exposure used while filming and by the effects of time and chemicals during processing. The quality of your camera and processor will determine how easily you achieve density uniformity and a densitometer should be used to check for density uniformity. *Note: All microfilm submitted to the Archives Division must have a density range within .80 to 1.25. There cannot be a greater than .15 density shift on an individual target or greater than .20 within each roll.*



ISO Resolution test Chart No. 2 is used in determining resolutions.

Document and Film Contrast
The contrast of the documents you are filming is determined by the range of brightness within them. For example, documents with faint text have a low contrast while documents with bold text have a high contrast.

The contrast of a photographic image is determined by the range of its densities (lightness and darkness). If images are black and white, or have a few shades of gray, they have a high contrast. Images that have a full range of tones are referred to as having a low contrast. The contrast of microfilm is determined by the contrast of the original, the type of film used (low or high contrast), the light source, the camera lens, and the chemical processing.

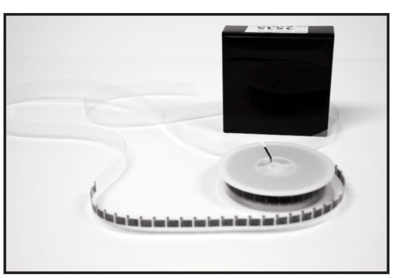
Reduction Ratio

This ratio refers to the size of the original in relation to the size of the image. Setting a camera at a lower reduction ratio will result in a higher quality image, but will use more film. Setting a camera at a higher reduction ratio will use less film, but the legibility of the documents will be determined by the capabilities of your camera.

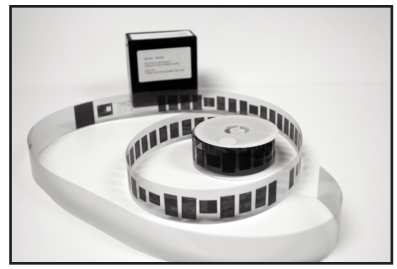
Film Size

There are generally three *formats* (sizes) of roll microfilm used: 16mm, 35mm, and 105mm.

16mm film is popular for filming large amounts of office documentation because of its cost and space effectiveness. Examples of records typically filmed on 16mm film are invoices, personnel records, payrolls and deeds. Over 3,000 documents can be stored on a roll of 16mm film.

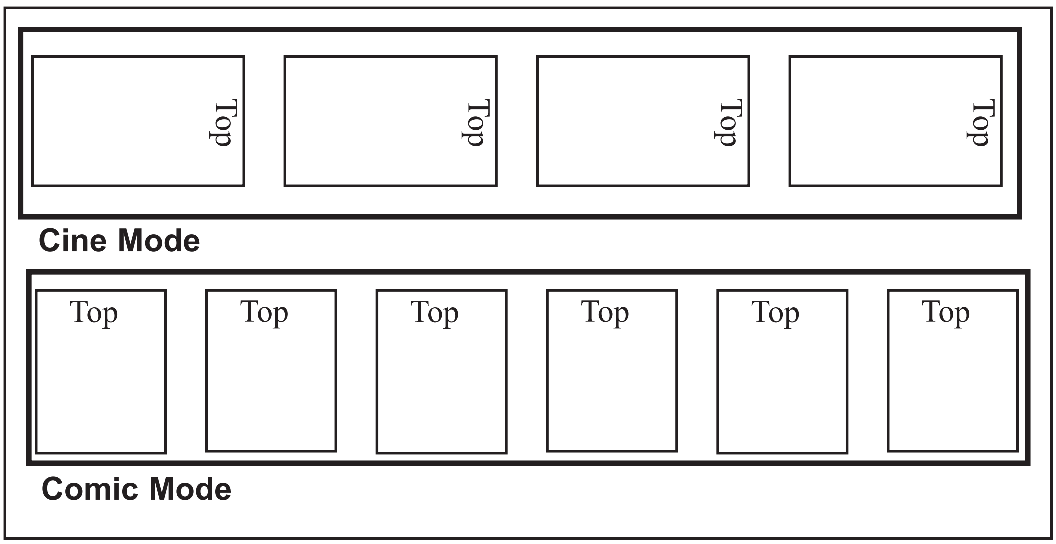


35mm film tends to provide better image quality and legibility. Since it is a larger film and can film documents at a lower reduction ratio, it is best suited for large format and finely detailed originals. Examples of records typically filmed on 35mm film are historical manuscripts, books, newspapers, maps and plans. Almost 1,000 images can be stored on each roll of 35mm film.

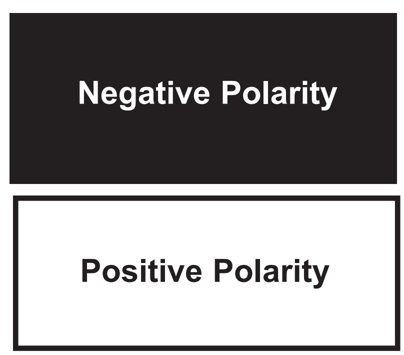


105 mm film is cut into microfiche cards. A typical microfiche card holds 98 images, but can hold up to several hundred, depending on the reduction ratio. Microfiche is best suited for records that need to be updated regularly or those that belong to a set collection. *Note: See ANSI/AIIM MS14-1998 Specifications for16mm and 35mm Roll Microfilm*

Image Position
End-user convenience should be considered when positioning documents in the vertical (cine) or the horizontal (comic) positions. However, optimizing film usage, document dimensions, reduction ratio, camera constraints, and the capabilities of viewing equipment will often determine *image position*.



Polarity
Does the microfilm you produce need to be negative, positive, or both? Except when you are producing microfilm COM (Computer Output to Microfilm) the *polarity* of the original microfilm you produce is always going to be negative. You can create either negative (white text on a black background) or positive (black text on a white background) copies during the duplication process depending on the type of duplicate film you use. Generally, people prefer to read text on negative microfilm. *Note: Duplication is discussed in Section 5.4.*



Film Type
The type of microfilm you use is an important factor in determining the “life expectancy” (LE) of your information. Look for the LE rating of any film you purchase. *Note: The LE of film is discussed in Section 3.1.1.*

Processing
The chemicals used in processing must be compatible with the specific film and processor. *Note: Film processing is discussed in Section 4.5.*

Storage
No matter how high the quality of the microfilm your system produces, the information on it may be lost if it is not stored under the proper conditions. Consider the storage needs of the microfilm before implementing any system. *Note: The standards necessary for security film storage are discussed in Section 5.5*

Storage at the Oregon State Archives

Security copy depository microfilm vault.

Section 3: Equipment and Supplies

This section will give you an overview of the equipment and supplies that are used at all levels of a micrographics program.

3.1 Production Equipment and Supplies

3.1.1 Microfilm

Microfilm is made of two layers: the *base*, or supporting layer, and the *emulsion*, or photosensitive layer. The base of the film consists of a single material while the emulsion consists of a variety of materials that determine the usage and the type of film it is.

3.1.1.1 Film Base

Acetate and *polyester* are the only base materials used in microfilm today. *Nitrate* or nitrocellulose was commonly used in the early twentieth century.

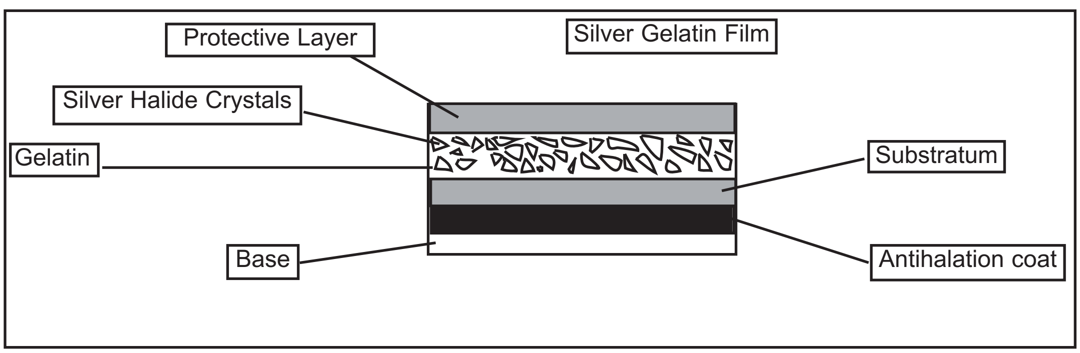
Polyester is a petroleum product, which has become the base material of choice in the micrographics field. It offers several advantages over acetate:

It is resistant to heat, humidity, and most chemicals.
It does not break or tear.
It does not become yellow or brittle over time.

3.1.1.2 Types of Film

Silver-gelatin, *diazo*, and *vesicular* are the three most popular types of film used in micrographics. Each type of film serves a different purpose during filming and duplication according to the design of its emulsion.

Silver-gelatin Film
The emulsion of silver-gelatin film consists of consists of silver-halide crystals suspended in gelatin.



If an agency possesses nitrate film it should immediately contact the
Office of the State Fire Marshal, 503-378-3473, for advice on disposal of the nitrate film. If the information on the film still ha value, it should be duplicated onto safety film (acetate or polyester).

Acetate is a cellulose derivative. Its primary advantage is its low tendency to generate static charges.

When light strikes the film the silver-halide crystals are partially converted tometallic silver nuclei and form a latent (invisible) image. To make the image visible, the film must be chemically processed, fixed, and then washed.

Silver-gelatin film is the only film that should be used in the camera. It produces a high quality image and has a life expectancy (LE) potential of 500 years, making it the only film suitable for filming permanent records._

Silver-gelatin film may also be used for creating duplicates of the camera film. However, due to the expense of silver-gelatin film it is recommended that diazo or vesicular film be used for duplicating working copies.

Silver-gelatin film does present certain problems. It is easily scratched, which can result in damage by use on a reader/printer, and gelatin is an organic compound, subject to bacteriological and microbiological damage.

Diazo Film
The emulsion of diazo film contains diazonium salts, azo dyes, and a stabilizing agent. During the duplication process the diazo film is put in contact with the emulsion side of the camera (silver-gelatin) film. Both films are then exposed to ultraviolet light, which breaks down the diazo compound.

Diazo film is developed thermally in an ammonia (or other alkali compound) chamber, in which diazonium salts and the azo dyes are coupled to form either a negative or a positive image, depending on the polarity of the original camera film. This means it is a “sign maintaining” film. That is, a negative master will produce a negative copy and a positive master will produce a positive copy.

Diazo film is inexpensive, and its durability, high resolution and fast duplicating speed make it ideal for high volume or routine duplication work.

Diazo film is made exclusively for duplicate printing and is not to be used as camera film. Its inherent instability makes it unacceptable for long-term storage. It should never be used as a back-up or security copy.

Vesicular Film
Vesicular film has an emulsion of stabilized diazonium salts sandwiched between two layers of plastic. When the film is exposed to ultraviolet light during duplication the diazonium salts decompose and release nitrogen gas in the film base. The ultraviolet light passing through the camera film creates a latent image on the vesicular film.

During the processing of the exposed film, by heat, tiny bubbles appear where the ultraviolet light penetrated the film base. These bubbles, or “vesicles”, become rigid when the plastic film cools and reflect the ultraviolet light, creating the final image.

Vesicular film’s sensitivity to light and sign-reversing characteristic makes it particularly well suited for fast on-line duplication of Computer Output Microfilm (COM). Like diazo film, it is inexpensive and durable. It also has the advantage of requiring no chemicals to process.

Vesicular film lacks the high resolution quality of diazo film and it should not be used for long-term storage. It is a “sign reversing” film, producing a positive duplicate from a negative master, and vice versa.

Thermally-Processed Silver (TPS)
Thermally-processed silver film, or dry silver film, is a non-gelatin film that records information by means of an electron or laser beam. TPS film contains silver-halide crystals or salts in its emulsion. The silver image material in TPS film is silver behenate, which is in close proximity to the halide crystals. The silver salts act as a catalyst on the silver behenate.

As in wet processed silver film, the silver halide receives the light and forms the latent image. When heat is applied to the film, developers in the film convert the silver behenate to metallic silver, which receives the latent image from the crystals and forms a visible image.

Since the developers remain in the film after development is complete, TPS film does not meet the standards for long-term storage. It is suitable for short- to medium-term storage applications, and is particularly well-suited for COM applications.

TPS is a "sign reversing", producing a negative from a positive source.

3.1.2 Microforms

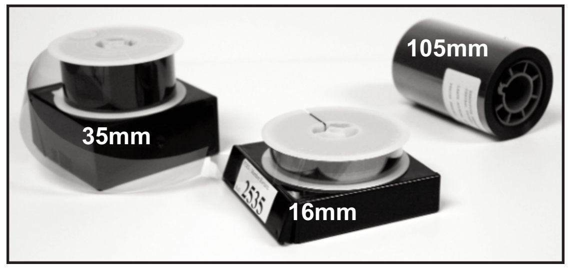
Microforms is the generic term for the different formats that microfilm comes in. The general definition for microforms is film that allows the reduction of small-size graphics and text to micro-images many times smaller than the original. Microforms generally fall into one of two broad categories, roll microfilm and unitized microfilm.

3.1.2.1 Roll microfilm

Roll microfilm is simply a length of microfilm rolled onto a spool. Depending on the thickness of the film base the length of the microfilm is usually 100, 125, or 215 feet and 16mm, 35mm, or 105mm (usually cut into microfiche cards) in width. The roll may contain images laid out in a "cine" (horizontal) format or a "comic" (vertical) format.

The advantages of roll microfilm are that it is inexpensive, stores a large amount of information in a small place, and guarantees file integrity. The disadvantages are that it requires sequential searching and information cannot be retrieved as quickly as it can on unitized microfilm, wear and tear occurs when it is used on a reader, and retrieval equipment (readers and reader/printers) are expensive. Use copies of roll microfilm may be placed in cassettes or cartridges to eliminate manual threading of film and to protect against dust, dirt, and fingerprints. Due to the proprietary nature of most cartridge or cassette retrieval systems they are not recommended for extended term storage of roll film.

Roll Microfilm



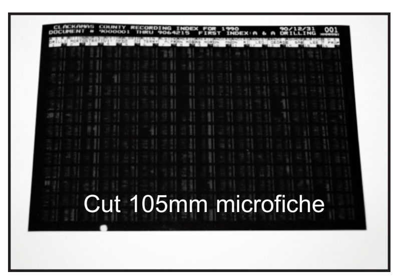
3.1.2.2 Unitized Microfilm

Unitized microfilm formats are those that contain discrete units of information. The "unit" may be a single document image or a series of documents relating to a single case or report.

Although there are some variations, unitized microforms fall into three main categories—microfiche, microfilm jackets, and aperture cards.

Microfiche

Microfiche is a 105mm by 148mm sheet of microfilm, which is produced on a step-and-repeat camera, or by making a contact duplicate of a microfilm jacket. The sheets contain micro-images permanently arranged in a grid pattern.



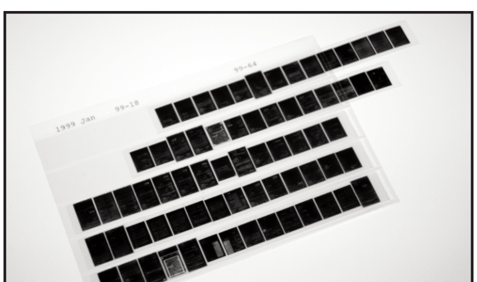
There is a header at the top of each sheet for eye-readable (no magnification required) identification. The headers may be color or digitally coded.

Like roll microfilm, microfiche has a high information storage density and the retrieval equipment for microfiche is inexpensive. However, it lacks file integrity because fiche can be lost or misfiled. In addition, step-and-repeat cameras are more expensive than most rotary and planetary cameras.

Microfiche is particularly appropriate for case file applications that do not require updating.

A variation on standard microfiche is *Computer Output Microfiche* (COM Fiche). In a typical COM application, digital information is either projected on a cathode ray tube and then photographed, or written directly onto film using a helium-neon (He-Ne) laser. The physical format of COM Fiche is otherwise identical to source document microfiche. *Note: See ANSI/AIIM MS5-1992 Microfiche*

Microfilm Jackets
Similar to microfiche, a *microfilm jacket* is a 105mm by 148mm plastic carrier with sleeves into which single images or short lengths of film can be arranged in a grid pattern. Either 35mm or 16mm images can be used.



Jacketed 16mm microfilm

As with microfiche sheets, jackets may have eye-readable and/or color-coded headers. The ability to rearrange images within the jacket or add subsequent images to the jacket makes this format well suited for case file applications that require occasional updating. This process tends to be labor-intensive and should be used only when the application is particularly well suited to this format. *Note: See ANSI/AIIM MS11-1987 Microfilm Jackets*

Aperture Cards
An *aperture card* is an opaque card with an opening to allow one image, usually 35mm or 70mm, to be inserted or mounted. The card itself affords the opportunity to present indexing, descriptive or other textual information in an eye-readable format to facilitate retrieval or understanding of the image. Due to the presence of antagonistic compounds in the adhesive and the acid in the card itself, it is not suited for long-term storage.

Aperture cards are usually used for large documents, which require extremely high resolution and a low reduction ratio, such as engineering drawings, maps, and charts.

A variation of the aperture card, the camera card, has raw stock preinserted in the card itself. Despite its ease of use, the proprietary nature of this technology makes it inappropriate for long-term storage.

35mm apperture cards

3.1.3 Cameras

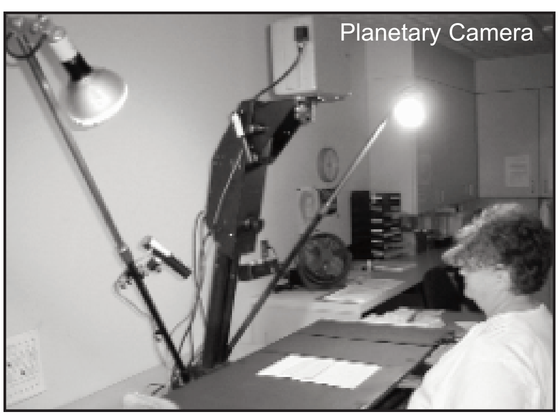
There are two basic types of cameras used in microfilming, *planetary* and *rotary*. There are different designs of each camera with varying capabilities.

Planetary Cameras

A planetary camera is a manually-operated microfilm camera that photographs a stationary document. The document lies on a flat surface and the camera itself is suspended above the document. This gives the camera the capability to film permanently bound books, large-sized documents, documents with overlapping attachments, and documents that are likely to be damaged if they are filmed by a rotary camera. Planetary cameras are also used for finely-detailed documents since they can achieve a higher resolution than most rotary cameras.

Many planetary cameras can use both 16mm and 35mm film. Others are restricted to only one film size.

Planetary cameras need to be carefully maintained. A vacuum cleaner should be used daily to make sure that all film shavings are removed from inside the camera body. The lens must be checked to ensure that it is secure. The film box should be checked regularly to make sure that the film advances smoothly. All lamps should be changed at the same time to ensure even illumination of the document and proper density levels.

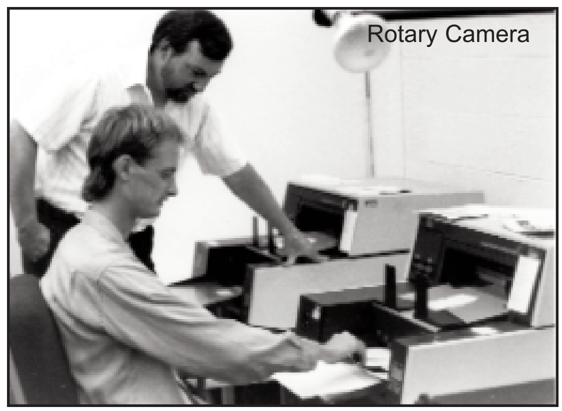

Planetary Camera

Rotary Cameras

A rotary camera, or flow camera, is an automatic microfilm camera in which the film and documents both move synchronously in opposite directions during exposure. The speed at which the documents move through the camera is determined by the reduction ratio used. If the documents are filmed at a reduction ratio of 1:16, the documents will move sixteen times faster than the film.

The rate at which rotary cameras capture images on microfilm is much faster than a planetary camera. A manually operated planetary camera will seldom film more than 1,000 images an hour, while a rotary camera can film up to 30,000 images an hour. Many rotary cameras can also place numbers and blips on the edge of the film.

Most rotary cameras use 16mm film. However, there are now some models which use 35mm film.


Rotary Camera

To ensure that a rotary camera operates properly, regular cleaning and maintenance is necessary. At a minimum, the camera should be vacuumed daily. Glass guides and mirrors should be cleaned weekly. If particularly dirty or dusty documents are being filmed, the feed rollers should be cleaned daily. The film drive should be cleaned regularly, and routine checks should be made of the lights to make sure that they are working properly. The lights inside the camera should all be changed at the same time to ensure even illumination across the entire document. *Note: See ANSI/AIMM Rotary Cameras for 16mm Microfilm – Mechanical and Optical*

Characteristics

Step-and-Repeat Cameras
A *step-and-repeat camera* is a motor-driven planetary camera that is used to film documents in a microfiche format. An internal mechanism positions the images in the necessary rows and columns to form a grid pattern.

3.1.4 Lighting Equipment and Controls

Proper and balanced illumination of your documents is essential to producing quality microfilm

3.1.4.1 Overhead Lamps

The three most popular types of lamps used in microfilming are *incandescent, quartz halogen, and fluorescent*. There are advantages and disadvantages to each lamp.

Incandescent
A set of four incandescent lamps has been a popular illuminating source for planetary cameras because the lamps last for long periods of time. However, bulbs of these lamps often dim at different rates as the tungsten inside them evaporates and condenses on their walls. This upsets the balance of light across the documents and makes it harder to maintain uniform density. To correct this all four bulbs must always be replaced at the same time.

Quartz halogen
The bulbs in this lamp contain halogen gas, which carries evaporated tungsten back into the filament of the bulb instead of allowing it to condense on the walls. Recycling the tungsten allows the bulbs to last much longer than the bulbs of incandescent lamps and also allows the illumination to remain constant until the bulb completely burns out.

Quartz halogen lamps give off more heat than incandescent lamps because they have to operate at a higher voltage in order for the tungsten recycling process to work properly.

Fluorescent
The insides of fluorescent bulbs are coated with white material called phosphor. The phosphor generates light when an electric current energizes it. During this process very little heat is produced. Due to their low heat output banks of fluorescent light are often used on cameras which film oversized documents. Moveable shields attached to the lamps provide balanced lighting over large areas.
As fluorescent lights age they are prone to flicker, thus causing exposure problems. Fluorescent tubes must be replaced as a set.

3.1.4.2 Voltage control device

Fluctuations in the voltage of your central power supply will lead to voltage fluctuations in your lamps as well. Even the slightest fluctuation can lead to problems with the density of your microfilm. Running your lamps through dedicated power lines will minimize voltage. A *voltage control device* will reduce any incoming fluctuations to within a few tenths of a volt.

3.1.4.3 Voltage readout device

Most microfilm cameras are equipped with dial voltage meters that cannot measure the voltage of the lamps to within tenths of a volt. In order to achieve such a precise reading a *voltage readout device* is necessary.

3.1.4.4 Exposure meter

An *exposure meter* is a hand-held device that can be aimed at an area of an illuminated document to measure light intensity and reflectance. Changes in the exposure setting can be based on this reading.

3.1.5 Processing equipment and controls

Your processor is the vital link between all the equipment that precedes it and the finished image. Any money you spend on quality imaging equipment will be wasted unless your processor is of equally high quality and is operated and maintained properly.
The capabilities of your processor are critical in determining the life expectancy of your microfilm. Not all processors are capable of producing microfilm that meets the requirements for long-term storage. The following performance characteristics are required in any processor that is expected to produce microfilm for long-term storage.

Consistent density from image to image, roll to roll, batch to batch.

Uniform density – no streaking or mottling.

Complete edge-to-edge processing.

Thorough washing (to long-term storage specifications)

Produces film, free of scratches, dust, chemical residue, water spots, physical damage.
Capable of processing different film types such as thick or thin base and films with different types of antihalation undercoats.

Variable speed control to meet optimal dwell time requirements.

Temperature controls capable of maintaining temperature to within 0.5 degrees F. of specified optimal temperature.

The volume of your microfilm work is an important factor in considering a processor.
Low volume: A small tank, typically one gallon, is recommended if you are running a low-volume operation. However, you will need to change the chemicals about every two weeks since chemicals weaken with time as well as usage. You will also need a system of pumps for recirculating chemicals from containers beneath the processor.
Medium volume: A tank with a two to four gallon capacity is recommended for mid-volume operations. Auxiliary chemical jugs should also be used to increase the chemical renewal capacity. Plumbing or a wash recirculation water cart may also be necessary.
High Volume: A deep tank processor is used for high volume operations because its longer dwell time allows the film to travel faster.

3.1.5.1 Processors

The most common types of processors used for developing microfilm are *tabletop, horizontal-path, and deep tank.*

Tabletop Processors
These processors are the most popular for agencies processing their own microfilm. Small in size, they require a minimum of operator training in order to be used properly. Characteristics of these processors include:
Ability to accommodate 16mm, 35mm, and 105mm film.

Self-threading.

Safe for room-light operation.

Variable speed control from 2.5 to 10 feet per minute.

Horizontal-Path Processors
Typically, these processors are tabletop models. Film is moved through the processing solutions horizontally. Characteristics of these processors include:

Ability to accommodate 16mm, 35mm, and 105mm film.

Self-threading.

Safe for room-light operation.
Variable speed control from 2.5 to 10 feet per minute

May accommodate multiple lengths of 16mm or 35mm film for simultaneous processing.

Deep Tank (helical- or sinusodial-path) Processors
These are large, somewhat more complex processors that are usually used for microfilm operations with a high volume. Generally, they are considered the only processors capable of producing film that meets the requirements for long-term storage. Deep tank processors require extensive training in order to operate properly. They provide the user with a high level of control over the processing procedure. Dwell time, speed, temperature, rod depth, and agitation are all operator-controlled. All deep tank processors require plumbing. The major performance characteristics of these processors are:

Ability to accommodate 16mm, 35mm, and 105mm film.

Requires a threaded leader.

Requires dark room operation.

Variable speed control, up to 200 feet per minute.

3.1.5.2 Sensitometer

A *sensitometer* is used to determine the sensitivity of film to light in order to ensure proper exposure settings. Sensitometers can test film either by varying illumination with a constant exposure or by varying exposure to constant illumination.

From these tests control strips are created. The control strips are used to monitor the consistency of the processor. Since the strips provide repeatable exposures each time they are taken, any changes in density will indicate a change in processing.

3.1.6 Inspection and Post-production Equipment and Supplies

3.1.6.1 Splicers

The desired life expectancy of your microfilm, materials of its base layer, and state standards will determine what type of *splicer* you use. Remember state standards also place restrictions on the number of splices that can be made on a roll and the distance between them. Informational targets must also be used to identify spliced retakes and their location. There are four types of splicers: *tape, solvent, thermal, and ultrasonic*.

Tape Splicer
The easiest way to splice two pieces of film is by splicing them with polyester tape. However, tape splicers should never be used with silver-halide films, or any film with a life expectancy of over 100 years, due to chemical reactions with the adhesive side of the tape.

Solvent splicer
Solvent splices are not recommended because chemicals in the solvents are harmful to silver film and the scraping of the emulsion creates a weaker splice. This type of splicing should only be used on cellulose acetate film. Before the film can be spliced the emulsion at the end of one piece of film must be scraped in order for solvent to be applied to its base layer. Once the solvent is applied the two pieces of film are clamped together in the splicer until

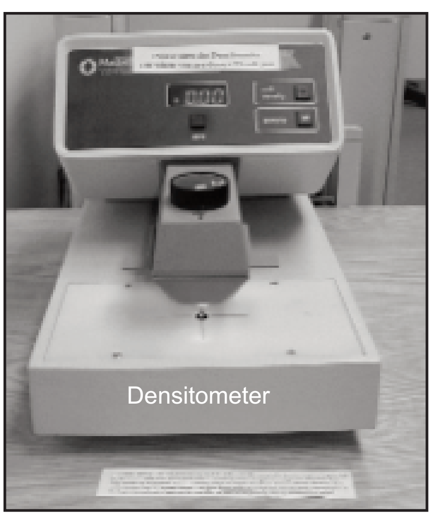
the solvent softens and fuses them together.

Thermal Splicer
Thermal splicing often leads to brittle or warped splices and is not recommended. This is another type of splicing that should only be done on acetate films. During thermal splicing the base layers of two pieces of film are put in contact with each other and heated until they melt together.

Ultrasonic Splicers
Ultrasonic splicing is the only acceptable method for splicing polyester films and any other long-term films. During ultrasonic splicing two pieces of film are placed against the "horn" of the splicer. The "horn" vibrates so rapidly that friction occurs amongst the molecules in the base layers of the film and causes them to melt together.

3.1.6.2 Densitometer

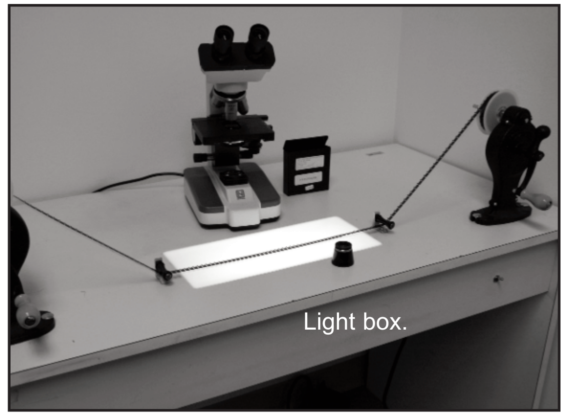
A *densitometer* measures the amount of light that is able to pass through a piece of film. A density reading is given after the densitometer sends a beam of light through the film. The less light that is able to pass through the film, the higher its density. *Testing microfilm with a densitometer is a necessary part of quality control.*



Densitometer

3.1.6.3 Light-boxes

A *light-box* is used to provide an evenly dispersed diffused light underneath the viewing area. Using a light-box microfilm can be checked, with or without a hand-held magnifier, for such noticeable errors as fingerprints, scratches, residues, and poor resolution.



Light box.

3.1.6.4 Microfilm Readers and Reader/Printers

To make sure that the microfilm is ready for viewing by the end-user, it is a good idea to inspect it with a *microfilm reader* or a *reader/printer*. A reader allows you to evaluate the overall crispness of the images and to make sure that documents have been filmed in the proper order. When you use a reader for quality control work it is extremely important that the film isn't damaged as it goes through the reader.

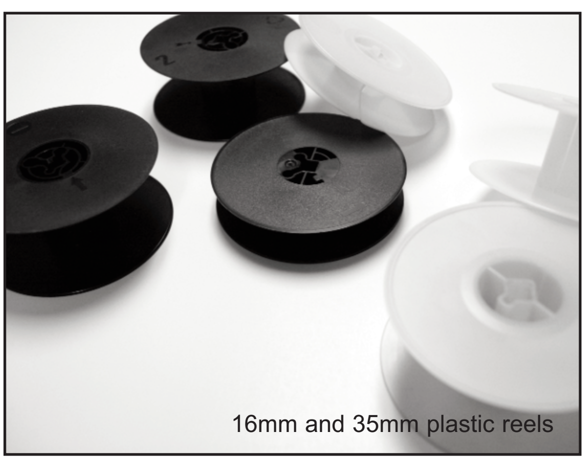
When selecting readers or reader/printers microfilm producers and end-users must consider many features, including:

Lens magnification
Exposure control
Lens interchangeability
Printing speed
Image rotation
Type of paper
Screen size, illumination, and focus
Paper size
Computer connection
Ease of use

Note: See ANSI/AIIM MS20-1990 Readers for Transparent Microforms – Performance Characteristics and ANSI/AIIM MS36-1990 Reader-Printers

3.1.6.5 Plastic Reels

Plastic reels used for 16mm and 35mm film must not contain any mold-release agents or plasticizers that can accelerate the deterioration of silver film. All film stored in the Security Copy Depository must be wound on plastic reels with dimensions that conform to *ANSI/AIIM MS34*; *Dimensions for Reels Used for 16 mm and 35 mm Microfilm.*



16mm and 35mm plastic reels

3.1.6.6 Storage Boxes

Each reel of microfilm should be stored in an individual and group box. Storage boxes are made out of plastic, cardboard or paper, and must be acid and lignin free. Boxes and their components (inks, paints, adhesives, labels, etc.) should be evaluated using the Photographic Activities Test administered by the Image Permanence Institute. Film stored in the Security Copy Depository must arrive in a properly labeled black plastic box.

Section 4: The Filming Process

4.1 Document Preparation

Preparing records for microfilming is essential to making sure the information is retained completely and efficiently. There are two steps that need to be taken;

1. Assessing the physical characteristics of the documents

2. Physically preparing them to be filmed

4.1.1 Document Characteristics

The physical characteristics of your documents have a direct bearing on how much it will cost to film them, how they may be filmed, and their usability once they are on microfilm. Consider the following characteristics of your documents.

Size
Most camera systems will accept a variety of paper sizes, and mixing paper sizes within a single filming application is acceptable.

Color
The recommended paper color for documents being filmed is white. Light pastel paper will usually provide an acceptable image. Dark colored paper: black, dark gray, purple, blue, green, red, or any shade of orange will result in extremely poor image quality; these colors should be avoided.

Type
The size and style of a document's text should be considered when assessing the quality of the image it will produce. Most microfilm systems will resolve type as small as eight points. Smaller type size should be avoided. An open sans serif typeface is the preferable type style. Script and italic styles will generally produce lower quality text on microfilm.

Contrast
The contrast between the text and the background paper is critical in producing an acceptable film image. Typewriters or printers should produce an even impression throughout the document.

Condition
Documents that are extremely fragile, deteriorating, dirty, or wrinkled will require special handling and filming techniques.

Once you have evaluated the physical characteristics of your documents you will be able to decide:

How long it will take to prepare and film the documents.

Which camera to use.

If the condition of any documents is too poor for them to be filmed successfully.

If the documents will need to be filmed under glass or in a book cradle.

The reduction ratio(s).

The exposure setting(s).

(Note: See ANSI/AIIM TR15-1997 Planning Considerations, Addressing Preparation of Documents for Image Capture

Physical preparation
Physically preparing documents allows for a smoother workflow during filming and will reduce the number of required retakes. It is recommended that the physical preparation of the documents be done by someone other than the camera operator and that it is done outside

the camera area. There are up to six steps involved in preparing your documents for filming:

Collation

Collation is the page-by-page inspection to identify conditions that the camera operator needs to be aware of. Conditions and concerns should be identified by either identification targets or instructional flags. Documents that may not photograph well, such as fax transmissions, should be photocopied onto plain paper. Collation concerns include:

Counting the number of necessary shots.

Noting the location of logical file breaks.

Noting documents that are missing, damaged, or out of order

Noting documents requiring multiple exposures.

Noting blank pages that should (or should not) be filmed.

All documents should face in the same direction, preferably the vertical (comic) format.

Bindings

If you are microfilming bound documents you may have to loosen or remove the binding in order for them to be filmed properly. Before making a decision contact the Archives Division.

Fasteners

All fasteners, such as paper clips and staples, must be removed. Files should be removed from their folders, unless the folder itself is to become part of the film record.

Repairs

During the preparation process minor repairs may need to be made to some documents. Any repairs made should be noted. Typical repairs include:

Tears: Torn records can be repaired with clear tape.

Dirt: Dirt, mold, and dust should be removed with a brush whenever possible.

Separating pages: Pages that are uncut or have become stuck together should be separated using a book knife.

Foldout and Oversize Materials

Foldouts and oversized materials should be flagged and the desired filming technique noted. There are two techniques:

Single exposure:
Only a single frame is
taken, but loss of detail can sometimes result.

Sectionalized exposures:
Multiple shots are taken, each comprising a section of the material.
The detail remains, but there may be problems with usability.

Flattening

Wrinkled, creased, or crumpled documents may be flattened on a press.

Targets

A *target* is a document or chart, which aids the technical or bibliographic control of a microfilming operation. Targets are filmed along with the documents themselves and thus become a part of the film. Targets can be separated into two general categories: *technical* and *informational*. *Note: See ANSI/AIIM MS19-1993 Recommended Practice for Identification of Microforms*

4.2 Targets

An informational target provides information about the filmed records. Informational targets may be used to impart bibliographic information, such as volume number, book number, roll number, creating agency, and contents. Informational targets may also be used to identify certain characteristics of a single original document that may affect the image quality or understanding of the record, such as missing pages or documents, documents out of order, and damaged records.

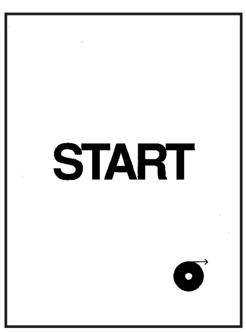
All targets described below are available from the Archives Division in both cine and comic format. The target orientation should match the document orientation, except for the resolution test chart targets. Resolution test chart targets may not be photocopied because the act of duplicating compromises the resolution of the target itself. Targets that require the preparer to add information may be completed by hand or typed.

4.2.1. Informational Targets

OAR 166-020 specifies informational targets that are required for long-term film. The use of other informational targets is optional. The following are required informational targets:

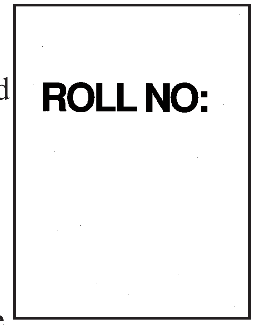
Start target

The “Start” target designates the beginning of the roll of film. It follows the resolution test chart pattern.



Roll number target

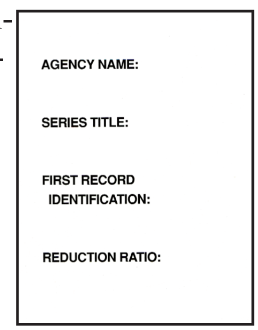
This target designates the roll number assigned at the time of filming. The numbering should reflect the filming sequence for each record series. The sequence should resume with each new filming session, not begin again with roll number one. The numbering system should assist in the retrieval of records. For this reason, each roll number should be unique and distinct.



The “Roll No.” target appears at the beginning of the reel immediately following the START target and at the end of the reel immediately following the Certificate of Legality and Authenticity.

Title Sheet Target

The title sheet target follows the “Roll No.” target. The title sheet target requires four pieces of information:



1. The name of the agency creating the records.
Example: Agency Name: Blacksmith Licensing Board

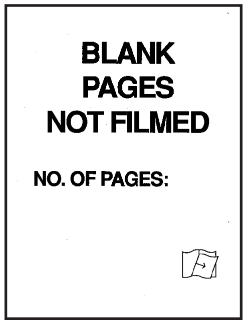
2. The series titles of the records, preferably as it appears on an approved retention schedule.
Example: Series Title: Complaint Files

3. The starting identification, (the first record that appears on the roll of film; any date span information which may assist in retrieving or identifying the records may be included here).
Example: Starting: Case #: 347

4. The reduction ratio used to film the records.
Example: Reduction Ratio: 24:1

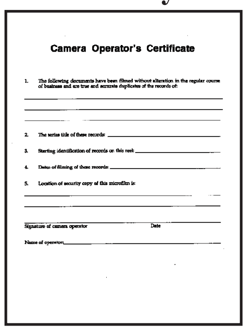
End Series Title Target

A second title sheet appears at the end of the roll of film, immediately following the body of documents. The second title sheet requires two pieces of information: the series title of the records and the last record on the roll of film.



Certificate of Legality/Authenticity

Also known as the Camera Operator's Certificate, or simply as the Certification, this target is used to certify that the records were filmed without alteration. It verifies the roll of film as a legal true copy of the original documents. The Certificate of Legality and Authenticity follows the second Title Sheet Target. The required pieces of information on this target are:



Statement certifying that the records were filmed without alteration in the regular course of business and are true and accurate duplicates of the records of...

Name of record creating agency.

Series title of the records.

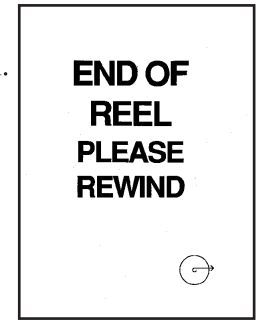
Date(s) of filming.

Name and signature of camera operator.

Date signed.

End of Reel Target

This target designates the end of a reel of film. It immediately follows the second "Roll No." Target and precedes three exposures of the density target or three blank white sheets.

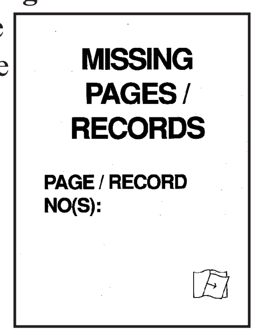


4.2.1.1 Optional Informational Targets

In addition to the informational targets described above, there are other informational targets that may aid in the use of the microfilmed records. The following targets are included in the Archives Division target package:

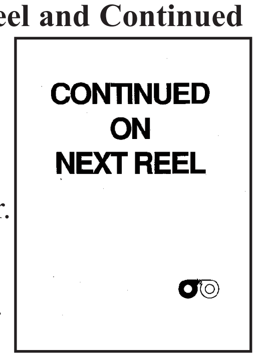
Missing Documents Target

Any documents that are known or believed to be missing at the time of filming shall be identified through the use of this target. It should be placed in the body of the film where the missing documents would normally appear. This target should be inserted in the appropriate places during the preparation process, before filming begins.

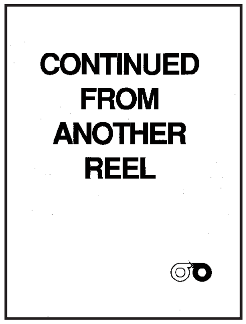


Continued On Next Reel and Continued From Another Reel Targets

These targets will normally be used in conjunction with each other. They are used to identify situations where a file or related groups of documents are found on more than one roll of film.



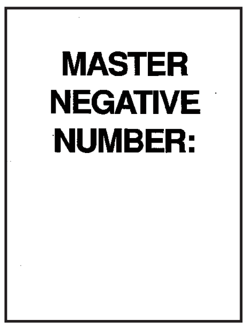
When used, the "Continued On Next Reel" target should immediately follow the body of the documents and precede the second title sheet target.



The "Continued From Another reel" target must appear at the beginning of the film immediately following the first Title Sheet target.

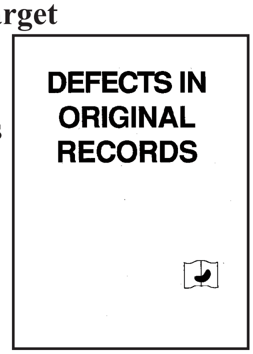
Master Negative Number Target

This target is used to track the activity and operations of a micrographic system. It may also be used to create a comprehensive log of an agency's filming program. The number is assigned sequentially, without a break or renumbering. It is independent of the type of records that are being filmed. If used, this target should immediately follow the "Start" target.



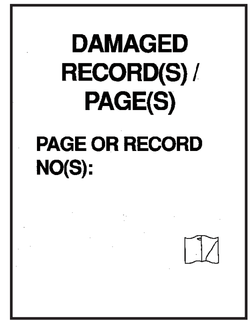
Defects in Records Target

This target is used to identify records with physical characteristics that may result in poor image quality, such as ink colors that do not photograph well, colored papers, light or extremely small lettering, or poor quality photocopies. This target is used in the body of documents and immediately precedes the document being identified. This target should be inserted appropriately during preparation, before filming begins.



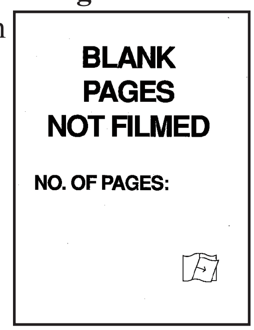
Damaged Records Target

This target identifies records or documents that have been damaged. Damage may include stains, water spots, tears, lost corners, or excessive wrinkling. It should be placed in the body of the documents immediately preceding the damaged record. This target should be inserted appropriately during preparation, before filming begins.



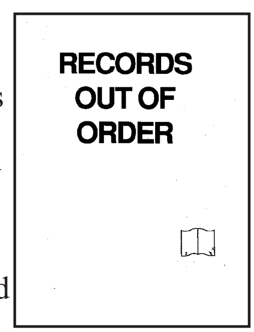
Blank Pages not Filmed Target

This target is used when blank pages are intentionally not filmed. It is used for two reasons: it preserves the integrity of the microfilm by identifying and clarifying any editing of the records, and it prevents confusion in cases where a film user would think that pages are missing. It should appear where the blank pages would appear if filmed. This target should be inserted appropriately during preparation, before filming begins.



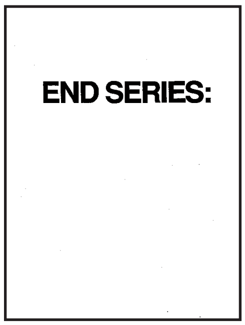
Records Out-of-Order Target

This is used to identify documents that are not filmed in sequence. It is placed in the body of documents immediately preceding the out-of-order documents. This target should be inserted appropriately during preparation, before filming begins.



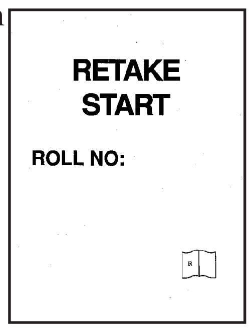
Begin Series Target and End Series Target

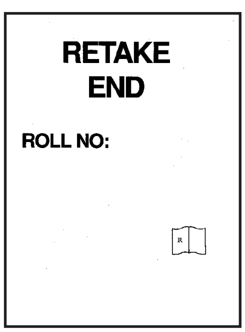
These targets will normally be used in conjunction with each other. They are used to identify situations where a file or related groups of documents are found on more than one role of film. *Note: If multiple series appear on one roll of film, the first Title Sheet Target should identify the starting series, and the second Title Sheet target should identify the ending series.*



Retake Targets

Three targets are used in the retake sequence. A "Retake Start" target is used to identify the beginning of the series of refilmed documents. This target is followed immediately by the use of a resolution test chart target, which directly precedes the documents being refilmed. The refilmed documents are followed immediately by an "End Retake" target. Both the "Retake Start" and "End Retake" targets require the roll number to be identified on the target.





The retake film may be placed at the start of the roll of film, at the end of the roll of film, or in the body of documents where they would normally appear if a retake had not been necessary.

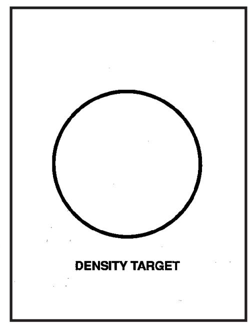
4.2.1.2 Technical Targets

Technical targets help the technical control of a microfilming system. They are used to determine the technical quality of the film, to maintain process control procedures of the micrographic system, and to measure the performance of duplicating systems and reader/printers.

Both density and resolution test charts are needed for long-term or permanent microfilm.

Density Target

A density target is used to measure the performance of the camera and processor. The density target is used in a sequence of three to evaluate the consistency of the density across the width of the film.



Uneven density across a series of three targets helps troubleshoot problems in a micrographic system.

White bond paper is an acceptable density target. A density target consisting of a black ring in the center of a sheet of plain white paper is included in the target packet available from the Archives Division. This target is designed to decrease reflectance. It is more useful for planetary cameras than rotary cameras. The use of either target is acceptable. Commercial vendors should supply their own technical targets.

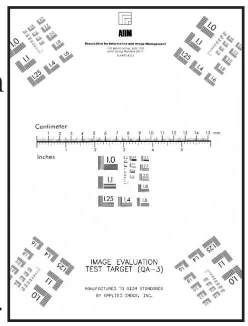
The series of three density targets appears at the beginning of the reel, following the leader, and again at the end of the reel immediately before the trailer.

Resolution Test Chart Target

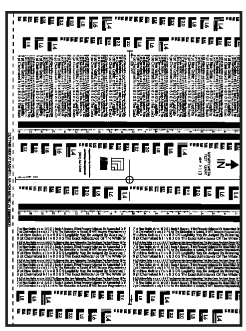
The resolution test chart targets (or camera targets) are used to measure the resolving power of a micrographic system. These targets are also used to measure the performance of duplicating systems and reader/printers.

Planetary and rotary cameras use different targets. It is essential to use the proper target. The appropriate targets are available from camera service vendors. Both types of targets are also available from AIIM, either directly or through the Archives Division.

Planetary Camera Target: The planetary camera card is an assembly of five ISO test chart #2, arranged in the center of, and diagonally across, a white plane. A ruler is printed horizontally across the center of the target, directly above the center test chart patern.



Rotary Target: Most vendors should have the appropiate resolution card for their rotary cameras. If such a card is not available, a rotary camera chart is available through AIIM, either directly or through the Archives Division. This chart consists of an arrangement of ISO test patterns, rows of alphanumeric characters of various fonts and sizes, and large shapes used for measuring reflectance and density.



The resolution test chart target follows the series of three density targets

4.2.3 Targeting Sequence

Oregon Administrative Rule 166-025-0020 specifies the following targeting sequence for all microfilm containing long-term or permanent records.

At the beginning of each roll targets must be sequenced in the following order:

A minimum of 24 inches of processed film; followed by

Three exposures of clean, blank white paper or the density target followed by

A planetary or rotary camera technical target of the type specified in *ANSI/AIIM MS19-1987; Recommended Practice for the Identification of Microforms* and *ANSI/AIIM MS23-1991; Practice for the Operational Procedures/Inspection and Quality Control of First-Generation Silver gelatin Microform of Documents* for the laboratory measurement of resolution and reduction ratio; followed by

A “Start” target; followed by

A “Roll No.” target, followed by

A title sheet target containing agency name, series title, starting identification, and reduction ratio.

All missing documents or records shall be so identified with an appropriate target.

At the end of each roll targets must be sequenced in the following order:

A target sheet containing series title and ending identification.

A certificate of Legality and Authenticity, including the name and signature of the camera operator; followed by

A roll number target; followed by

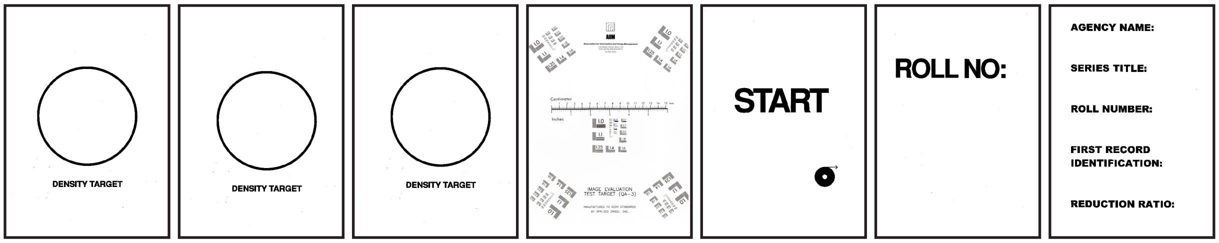
An “End of Reel” target; followed by

Three exposures of clean, blank white paper or the density target, followed by

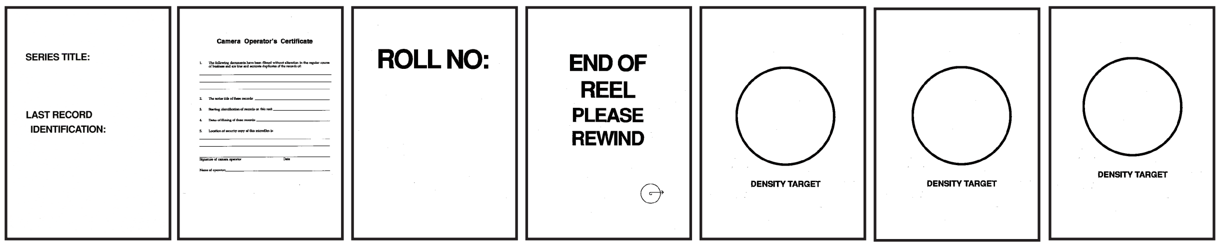
A minimum of 24 inches of exposed and processed blank film.

Target sequence summary.

Beginning target sequence.

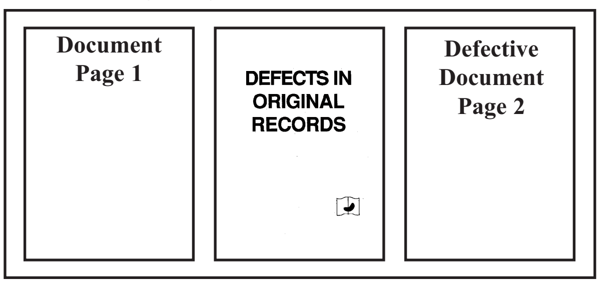


Ending target sequence.

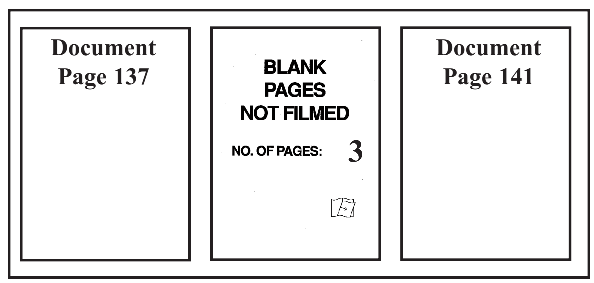


Note: There can be no splices between any technical targets and the documents.

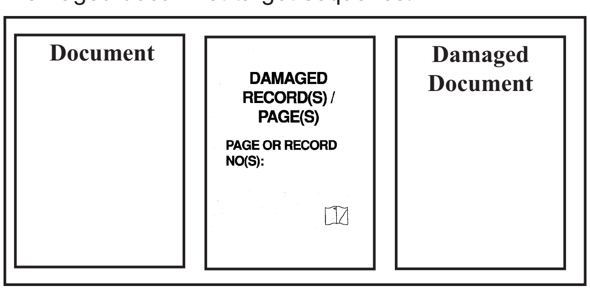
Defective page target sequence.



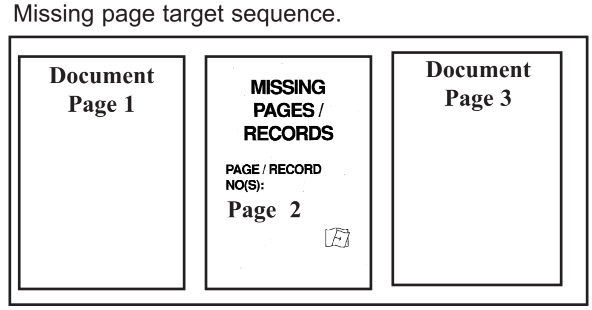
Blank page target sequence.



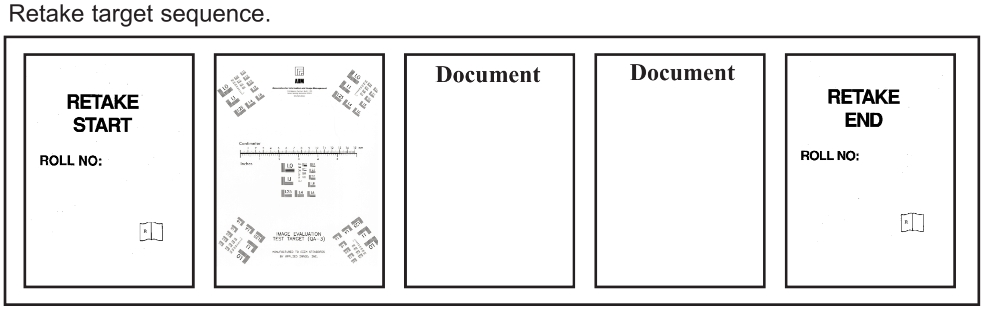
Damaged documnet target sequence.



Missing page target sequence.



Retake target sequence.



4.3 Film indexing

In order to retrieve microfilmed records quickly and easily a method of *indexing* needs to be established. Selection of an indexing scheme is determined by the amount and type of records being filmed, the anticipated frequency of retrieval, the use of the images once they have been retrieved, and the time it will take to retrieve the images.

Several methods are used to index roll microfilm. They can be classified as either manual or automated retrieval methods.

4.3.1 Manual Retrieval

Flash Card Indexing
Flash card indexing is the simplest way to index roll microfilm. A label is put on the microfilm's box, listing the contents. A system of "flash cards" and blank frames are used to separate the groups of images on film, similar to folders in a conventional paper filing system.

The user advances the film through a reader, monitoring the flash cards as they advance, until the desired document or file is retrieved. The flash cards must be easy to distinguish from the documents and should be designed to

be very noticeable, even as the film is rapidly advanced through a reader.

The flash cards should be inserted appropriately during preparation, before filming begins.

Odometer Indexing
Some cameras and readers are equipped with *odometers*, which measure the linear distance from the beginning of the roll to each individual image on the roll. An index is prepared after filming, which identifies the location of each image. The user consults the index, determines the distance from the start of the roll to the desired image, inserts the roll into a reader, and advances to that spot on the film. Odometer systems have basic flaws. Odometers are not standardized, so the odometers on equipment (cameras and readers) from different manufacturers may not measure the same distance. In addition, any subsequent physical alteration of the film, such as amendment, expungement, late retakes, or leader replacement, can make the index inaccurate.

Sequential Numbering
Sequential numbering is the most straightforward manual indexing technique. Sequential numbers may be filmed in each frame with an index prepared after filming. The user may then consult the index, identify the desired document by frame number, and advance the film to that particular frame.

4.3.2 Automated Retrieval Image Count (Blip Encoding)

This method of indexing and retrieval uses small squares, or *blips*, of a constant size and density, that are recorded on film as each document is photographed. An index is created which identifies each document with its particular blip number.

The user places the film (usually in a cartridge or cassette) in the reader and enters the desired document blip number on a keypad attached to the reader. A photocell in the reader recognizes and counts the blips and then advances to the desired document. *Note: See: ANSI/AIIM MS8-1988 Image Mark (Blip) Used in Image Mark Retrieval Systems*

Photo Optical Coding
Photo optical coding uses codes, which resemble barcodes, to index film. A special-

ized reader is used to find documents based on their codes. More precise levels of indexing can be achieved with photo optical coding than with image count indexing.

4.3.3 Computer Assisted Retrieval (CAR) Systems

Manual and automated retrieval systems can be used when records are sequentially or otherwise logically arranged on film and do not need to be located in a criteria-specific or advanced search. When records are not filmed in any logical sequence or need to be located through a complex combination of criteria a more sophisticated retrieval system needs to be used.

A *Computer Assisted Retrieval (CAR)* system allows for the on-line entry of indexing information to a database management system to create, maintain, retrieve, and manipulate an electronic index to the locations of records on film. The index information may be linked to filmed record identifiers, such as blips, or may be text-associated.

Sophisticated CAR systems can conduct Boolean searches and display microform addresses in complex relationships. A CAR system is necessary to any application that calls for the integration of microfilm into an active information management system.

4.4 Filming

In order for records to be microfilmed to meet quality standards a *filming environment* must be created so that outside influences can be eliminated and camera settings can be properly controlled. The filming environment is often located in a separate room or cordoned-off area.

4.4.1 Filming Environment

Conditions of the camera, film, and camera operator must all be taken into consideration when planning the filming environment.

Vibrations
Resolution is lost if the camera or documents vibrate during filming. Consider outside influences that could cause vibrations while planning your filming environment, air conditioners, traffic, footsteps, etc. Sometimes mechanical components inside a camera will cause it to shake. Small vibrations may often go undetected until the proper resolution tests are conducted.

Power Source
Voltage fluctuations from your power supply will lead to density problems in your microfilm. Avoid this by having each camera run off a separate dedicated power line. Installing a voltage regulator will further ensure an even flow of power.

Ambient Lighting
Ambient light (light from a source other than the camera lamps) must be kept to a minimum during filming and the loading and unloading of film. Excessive ambient light may lead to fogging and density problems. Using light-absorbing material to curtain off the filming area is a popular method for reducing ambient light.

Relative Humidity
To avoid static discharge marks and cling on film, moisture should be added to the air in the filming area when the weather is dry and conditioned (dried) to any desired level when the weather is humid.

Temperature
The temperature and relative humidity in the camera area affects the comfort and perform-

ance of the camera operator. Filming areas should be open enough and spaced far enough apart to stop the temperature from rising to uncomfortable levels.

Ventilation, Filtration, and Cleaning
Dust settling on lenses and mirrors can upset the resolution and contrast of your camera. Molds can cause health-related problems for the camera operator. Equipping the filming area with the proper ventilation and filtration systems accompanied by regularly cleanings will greatly reduce these problems.

4.4.2 Camera settings

The camera operator must constantly evaluate the documents being filmed and adjust camera settings accordingly. Among the factors the operator will need to consider are exposure, lighting balance, focus, reduction ratio, image format, image spacing, and depth of field. If a camera operator is unsure of which camera settings to use they should refer to Section 8.2 of *ANSI/AIIM MS23-1998*.

4.5 Processing

Processing exposed film consists of four steps: *developing, fixing, washing, and drying*. Chemicals are used, which are subject to breakdown, impurities, and misuse. Each of the four steps must be performed properly in order to achieve the quality standards necessary for duplication and long-term storage.

4.5.1 Development

The chemicals used in silver film development have one primary function: to selectively convert the exposed silver-halide salts, in the emulsion of the film, to metallic silver while ignoring the crystals that were not exposed.

The key chemical in the development process is called the *developing agent*. There are many different types of developing agents to choose from. The developing agent you use will determine certain characteristics of your film, such as density and resolution.
Another chemical used in processing is called the activator. The role of the activator is to control pH levels in all the chemicals during processing. Balancing pH levels ensures that only exposed silver-halide salts are reduced to metallic silver. This results in the film having the proper density.

Time and temperature are key factors to film development once it has been immersed in the developer. The longer the immersion time the higher the density and contrast. If the film is immersed for too long chemical fogging will occur.

The temperature of the chemistry determines the rate of development. As temperature increases, the rate of development, and consequently, the density of the film, increases. Temperature variation as little as one degree Fahrenheit will affect the density of the film. The temperature control of the processor is extremely critical and must be monitored at all times. If a processor does not have temperature read-out gauge, a tank thermometer should be used to monitor the solution temperature.

Once the development has started, the developer in contact with the emulsion becomes exhausted. To fully develop all of the film fresh developer must be brought in. This is the role of agitation. Most processors are automatic, and agitation is not an area of great concern. However, if film demonstrates chronic problems with uneven density, a service agent should check the agitation action of the processor.

Developers are available as a pre-mixed solu-

tion or as a concentrate. Pre-mixed developers avoid the concentration variable but are considerably more expensive than concentrates. Pre-mixed developers may also require film to be immersed longer since they are more diluted than concentrates.
Developer solutions begin to oxidize immediately upon exposure to air, so it is important to add water to the developer, not vice versa, to decrease the amount of oxidation when mixing concentrated developers.

During development oxidation, polluting of the developer by its own by-products, and the movement of film from tank to tank begins to affect both the quality and quantity of the developer. Each processor is rated for the amount of film it can process before the developer needs to be replenished. Failure to properly replenish the developer, whether manually or automatically, will hinder its effectiveness.

4.5.2 Fixing

After development, the emulsion of the film still contains unexposed silver-halide salts. These salts are still light sensitive, and must be removed from the film to make the image stable. The solution used to do this is called ammonium thiosulphate or hypo. Hypo holds the silver-halide salts in a solution until they can be removed from the film during the washing process.

Improper fixing or the use of exhausted hypo will result in cloudy or hazy looking film, which cannot be corrected through additional washing. Eventually, these cloudy areas will become discolored, critically compromising the quality and readability of the filmed images.

Fixing, like development, is dependent on the proper concentration of chemicals, agitation, temperature, and time. Additionally, the thickness of the emulsion, the coarseness of the film grain, and the type of antihalation layer of the film may determine the effectiveness of the fixer. A processor's manual will give you the proper operating controls for these film characteristics.

4.5.3 Washing

After fixing, the film contains soluble chemical compounds, fixing chemistry, and silver-halide salts. Rapid and eventual total density loss will take place if these elements are left on the film.

The effectiveness of the washing process is controlled by water temperature, water purity, flow rate, the wash mechanism, time, and pH levels.

Water Temperature
Higher water temperatures during washing are more effective than lower temperatures. The higher the water temperature is the faster the film can be washed. However, if the temperature is too high excessive swelling of the gelatin will occur which will result in the softening of the emulsion. Water temperature should never exceed 110 F.

The temperature of the water must be equal to the previous temperatures of the developer and the fixer. Temperature differences in these solutions will lead to wrinkling in the gelatin.

Water Purity
Before installing a processor the purity of the water supply must be checked. If your water does contain impurities they can be removed through filtration and/or water softening systems.

Flow Rate
Chemicals being washed off the film cause

contamination in the water. In order to reduce the levels of contamination fresh water must constantly flow into the processor. The rate at which fresh water flows into the processor is determined by the amount of film that is being washed and how long it needs to be in the washing cycle. Spots and stains can occur on the film if there is an insufficient flow rate.

Wash Mechanism

The movement of water as it flows into the processor is as important as the rate. The most effective washing method is to have water enter through the bottom of the tank and flow out the top carrying the unwanted chemicals with it. Another good method is to have jets put water directly on the film.

Time

Like all the previous processing steps, time plays an important role in the washing process. The film must remain in the water until all the unwanted chemicals are removed. Remember, the lower the water temperature and flow rate, the longer the film will take to wash.

Water pH

A pH level between 7.0 and 8.5 is needed to wash film effectively. If the pH level is too high it can cause the gelatin to swell and if it is too low it can cause the gelatin to shrink.

Drying

During the drying stage all moisture must be absorbed from the gelatin. Temperatures during drying should not exceed 140^0 F. for acetate film and 160^0 F. for polyester film. Overdrying film can cause excessive curling, which causes the film to jam in the processor. Film that is not completely dried tends to stick together when it is wound and leads to the film layers becoming detached when the film is unwound.

The drying box of the processor must be grounded to avoid static electricity buildup. Static can produce permanent marks on film.

Process Controls

Process controls are intended to monitor the performance of the camera and processor. They are an essential part of any micrographics operation and should be performed without interrupting the workflow.

Camera process control

A key part of *camera process control* is the use of technical targets on each roll of film. The *density target*, used in a series of three, will indicate illumination problems immediately. If the density target is on regular paper it can also be used to test the action of the transport system in a rotary camera. *The resolution test chart target* will test the focal accuracy, reduction ratio, and performance of the lenses. Problems with these factors will show up immediately when film is inspected.

A photometer (light meter) may be used to measure the balance of illumination across the filming plane. A line voltage meter may be used to monitor any voltage changes in the camera.

Processor Process Control

An important part of the *processor process control* is regular *methylene blue testing*. This measures the residual thiosulphate ion concentration on the film after processing. *OAR 166-025-0015(6)* specifies that the thiosulphate level after processing should be no more than 0.014 grams per square meter of film (1.4 micrograms per square centimeter). Levels higher than this indicates that the film was washed inadequately and that servicing the processor is required.

If the residual thiosulphate ion concentration level is consistently high, a service agent may

suggest the use of clearing and stop baths after the fixing state to remove all residual thiosulphate. The Archives Division does not recommend this. Studies indicate that a low level of thiosulphate should remain on the film to enhance its longevity.
The methylene blue test is somewhat complicated to perform and extremely expensive to equip at the outset. Most service bureaus or film supply vendors will perform this test for free or at a minimum cost. To do this, simply remove a short section of the leader and send it to a vendor for testing. The test must be performed within two weeks of the processing to be accurate.

The other major part of processor process control is the use of process control strips. The purpose of a control strip is to monitor the consistency of the processor. The control strip contains steps of increasing densities that have been pre-exposed on a sensitometer. The processor is tested by processing the control strip. Since the exposure of the steps is tightly controlled, any variation in the density of the steps after processing indicates inconsistencies with the processor.

Process control strips must be kept frozen until they are used. Failure to keep them frozen will result in latent image fade and inaccurate results after the strips are processed. Before they are used the strips should be allowed to reach room temperature. Since there is likely to be some small variation between different batches of strips, one strip from both the new and the old batches should be processed together to gauge the acceptable limits of each strip.

There are other process control aids which are helpful in monitoring the processor's performance. A tank thermometer should be used to monitor the temperature of the developer solution and a pH meter should be used to monitor balance of the wash water.

4.6 Quality Control Inspections

Quality control inspections are performed by inspecting finished microfilm to ensure that it meets the necessary quality standards. These standards are found in *OAR 166-025-0015*. Microfilm should be inspected for any signs of camera or processor malfunctions immediately after it has been processed, so that repairs can be made and the amount of defective film produced can be kept to a minimum. After this initial inspection for obvious defects more thorough inspections must be made of both the informational and technical content of the film. These inspections are performed to check for:

Informational content: Missing pages or targets, out-of sequence images, readability.

Technical content: Density, resolution, fogging, spotting, streaking, scratches, fingerprints, ripped edges, focus, skewed images, proper reduction ratio, erratic spacing, overlapped frames.

OAR 166-025-0015(5) specifies the degree of quality control inspection required for long-term or permanent film. More guidelines for quality control inspections can be found in Section 10 of *ANSI/AIIM MS23-1998* and in the "Troubleshooting Guide" of the next section.

4.7 Troubleshooting Guide For Quality Control Inspections for first generation camera negatives:

Problem System Component Possible Cause Recommended Action

Clear Film (no Image)
Film
Camera
Processor Defective Film (uncoated film base)
Overexposure
Undeveloped; may have been fixed Try new lot of film
Check lamp and shutter assembly;
Adjust exposure
Verify chemicals in tanks

High Density
Camera
Processor Overexposure
Overdevelopment Shutter speed too slow;
Lens aperture too large;
Lamps too bright.
Developer too hot;
Processor speed too slow;
Developer improperly mixed (too concentrated).

Low Density
Camera
Processor Underexposure
Underexposure Shutter speed too fast;
Lens aperture too small;
Lamps too weak, dim.
Improper replenishment;
Developer temperature too low;
Processor speed too fast;
Developer improperly mixed (too weak);
Developer agitation too low.

Fogging
Film
Chemistry
Lab room
Camera
Processor Deteriorating or expired film
Old or contaminated chemicals
Light contamination
Light leak into film box
Developer temperature too hot Purchase new film stock;
Store unused film in cold storage.
Check expiration of chemicals; order fresh chemistry.
Follow safe-light recommendations for your processor operations and film-loading procedures.
Check film box for cracks, leaks;
Check operator's film-loading procedures - make sure film is not exposed to room light during loading.
Check temperature of developer tank.

Edge fog
Processor Aerial oxidation of developer on film; caused by incomplete immersion of film in developer
Check replenishment rate; check developer level in tank.

Yellow fog *Processor* Developed in exhausted developer
Contamination of fixer by developer
Inadequate fixing Adjust replenishment rate.
Check and replace rollers; perhaps add wash step after development.
Adjust fixer replenishment rate; check age of fixer, use fresh hypo.

Uneven density
Film
Camera
Processor Out-of-date film
Mirrors out of adjustment
Uneven illumination
Emulsion deterioration
Temperature variations
Poor agitation
Processor speed variations Try new film lot.
Adjust mirrors.
Replace all lamps at the same time, realign if necessary
Drying temperature too high.
Check tank temperatures.
Check agitation in development and fixing stages.
Check for power surges to processor.

Small black spots *Processor* Undissolved particles that have stuck to the emulsion of the film Check water filtration. **Pinholes** *Processor* Dust or dirt on emulsion

Small air bubbles during processing

Splashes of fixer onto film prior to development Clean rollers.

Check replenishment rates.

Check level of fixer in tank. **Reticulation (emulsion layer with patterns of irregular lines)** *Processor* Abrupt swelling and contraction of gelatin due to: (a) going from very acid to very alkaline solution or vice versa or (b) going from warm to cold solution or vice versa Check pH and temperature of all tanks. **Mottling (network of density patches)** *Processor* Inadequate agitation or improperly mixed chemistry Check agitation; expiration date of chemistry; replenishment rates. **Milky appearance** *Processor* Inadequate fixing

Water too hard Refix film; check age and temperature of fixer; adjust replenishment of fixer.

Use softer water **Grainy surface** *Processor* Water too hard Use softer water **Problem System Component Possible Cause Recommended Action Deposits of crystals on film** *Processor* Inadequate final wash Check wash rate and processor speed **Dark, tree-shaped marks (static charge marks)** *Processor*

Camera Dry box too hot or not grounded

Film wound too quickly in box Ground dry box; check drying temperatures; increase room humidity.

Check speed of film winding in camera box **Scratches** *Camera*

Processor Sharp edges or irregularities in the film path

Sharp edges or irregularities in the film path Adjust film gate;
Check film threading mechanism;
Clean camera thoroughly.

Clean rollers. **Two images on one frame** *Camera* Film transport mechanism Have film transport serviced **Frilling (peeling of emulsion)** *Camera*

Processor Film transport may be damaging film

Excessive drying or developing temperatures

Excessively soft water Have film transport serviced.

Check temperature of tanks and dry box.

Use harder water. **Jam** *Camera* Document transport mechanism Have serviced; make sure pathway is clear of debris. **Dark streak** *Camera* Bright object in plane

Lamps or mirrors out of position Clear document path.

Check lamps and mirrors. **Light streak** *Camera*
Debris between lens and document
Lamps or mirrors out of position or broken Clear document path. Check lamps and mirrors.

4.8 Retakes and Splicing

A *splice* is formed when two separate pieces of microfilm are joined together. Splicing that is performed improperly or not in accordance with ANSI/AIIM standards may lead to problems viewing and duplicating the microfilm. Improper splicing may jeopardize the legal admissibility of the microfilm. All splicing must meet the operational requirements of *ANSI/AIIM MS18-1991; Splices for Imaged Film – Dimensions and Operational Constraints*.

Any microfilm that is produced to replace a segment of film from an original reel is referred to a *retake.* The retake often replaces a segment of film that has either technical problems or images that are out-of-order. The segment that the retake is replacing is removed from the reel and the retake is spliced in its place. A retake must include, at minimum, the two frames that precede and follow the frames being retaken.

Three targets are used in a retake sequence. A **"RETAKE START"** target is used to identify the beginning of the sequence. This target is followed immediately by a **"RESOLUTION TEST CHART TARGET,"** which directly preceeds the documents being refilmed. The refilmed documents are followed immediately by a **"RETAKE END"** target.

Both the **"RETAKE START"** and the **"RETAKE END"** target require the roll number to be identified on the target.

The retake film may be placed at the beginning or end of the reel or in the body of the documents where the documents originally appeared.

Security rolls should be splice free. If splices are unavoidable, no more than six splices can be made. If more than six splices are required, a new splice free security silver duplicate should be produced.

There can be no splices between any technical targets and the documents.

4.9 Expungement

Expungement requires the total removal or obliteration of filmed images, leaving no evidence that the original image ever existed. Expungement can be performed by removing the unwanted film and then splicing the remaining film together, or it can be performed using the more complicated abrasion technique that does not require splicing.

To maintain the legal integrity of altered film, proper documentation of the expungement must be inserted in the film. This documentation must never include confidential information. Expungement must only take place after an expungement order has been issued. Expungement is a difficult technical procedure that should never be attempted without proper training. Improper expungement techniques can lead to permanent damage of the film and unintended loss of information from the records. For all expungements refer to *ANSI/AIIM MS42-1989: Recommended Practice of the Expungement, Deletion, Correction, or Amendment of Records on Microform*.

Section 5: Post-Filming Operations

After microfilm has been produced according to the required specifications and verified through the inspection process it will be ready for duplication and storage.

5.1 Duplication

Silver, diazo and vesicular film can all be used for *duplicating*. However, silver duplicates are considerably more expensive to produce than diazo or vesicular. When choosing which type of film to duplicate with, the first thing you should consider is whether you want the images to be negative or positive. Remember the master copy is always negative unless it is produced by a COM system.

Diazo film is sign maintaining. A negative master will produce a negative duplicate.

Vesicular film is sign reversing. A negative master will produce a positive duplicate.

Silver film can produce either a negative or a positive duplicate from a negative master.

The contrast of the original film must also be considered. If both the film and image density is of the master is uniform throughout, a high contrast film may be used. If the densities vary, a medium contrast film is recommended.

Diazo film is available in both high and medium contrast. The contrast of vesicular film is a function of the projection system used for viewing. A projection system with no condenser and a wide aperture will project a low contrast image. The same film viewed on a projection system with a condenser and a small aperture will project a high contrast image. Silver duplicates approximate the contrast of the original film.

No matter which type of film you choose to use for duplication, it is important that the density of the duplicate film falls within a certain range. This will help ensure a long-lasting, stable duplicate. Figure __ shows the aim point densities for duplicate microfilm. These guidelines should be followed as closely as possible.

Here is a short list of advantages and disadvantages for each type of duplicating film:

Silver Duplication

Advantages:
ÆMay be either sign maintaining or sign reversing.
ÆContrast approximates that of the master; less concern about selecting the appropriate film for its contrast properties.
ÆIn cases of emergency, a new security silver can be duplicated from the working copy.
ÆMay easily be converted to unitized formats (jackets, cards).
ÆProvides a pleasant, easily viewed contrast on reader/printers.

Disadvantages:
ÆMost expensive of the options.
ÆAbrades easily.
ÆIs subject to oxidation and other forms of deterioration in a working environment.

Diazo Duplication

Advantages:
ÆAvailable in a variety of contrasts and colors.
ÆInexpensive and easy to produce.
ÆProvides a pleasant, easily viewed contrast on reader/printers.
ÆMay easily be converted to unitized formats.
ÆPhysically durable, not easily scratched.
ÆIn case of emergency, a new security silver

can be duplicated from the working copy.

Disadvantages:
ÆRequires the use of a potentially dangerous duplicating system (ammonia or other alkaline compounds).
ÆSubject to fading after prolonged exposure to heat and ultraviolet light, including that from a reader/printer.

Vesicular Duplication

Advantages:
ÆInexpensive and easy to produce.
ÆVery durable. Not subject to scratching or fading.

Disadvantages:
ÆMay require refitting reader/printers to narrow the aperture for a good, high contrast image.
ÆMore difficult to unitize.
ÆLow visual contrast may be unpopular with users.
ÆDifficult to generate a new security silver copy in cases of emergency.

5.2 Film Handling
Since the oils from skin damage film, clean white cotton gloves must be worn at all times when handling microfilm. Always hold film by the edges or by the leader/trailer. Security film should only be handled for inspections or duplication. Security film should only be viewed on a light table. Silver film should never be viewed on a reader where scratching can occur.


Cotton gloves

5.3 Packaging

Microfilm should be stored in both an individual and a group container. These containers must be made of either plastic, paper, or cardboard and be free of any chemicals that could cause damage. Plastic containers must be peroxide-free. Paper or cardboard containers must be acid and lignin-free. Any container you use should pass the Photographic Activities Test performed by the Image Permanence Institute.

Rubber bands must never be used to restrain film on the cores. The only acceptable restraint is a paper band. If used, paper bands must meet the requirements of *ANSI IT9.2-1991 For Imaging Media – Photographic Processed Films, Plates, and Papers – Filing Enclosures and Storage Containers*, and be made of acid-free, lignin-free paper. In most cases, no restraint is necessary.

Never keep the film wound too tightly or loosely inside the container. Over-winding the film can cause scratches and breaks in the emulsion. Winding the film too loosely can lead to warping.

Reels must conform to *ANSI/AIIM MS 34-1990 Dimensions for Reels Used for 16mm and 35mm Microfilm,* and be constructed of inert plastic. Cassettes, cartridges, or other types of proprietary user formats are not recommended for security film.

Roll film is the only acceptable format for film being deposited in the long-term or permanent vaults of the Security Copy Depository (SCD) at the Archives Division. Each reel must be properly labeled and individually boxed in an inert acid-free black plastic container.

Top label.

Agency name
Series Title
Reel number

Front label.

Agency name
Series Title
Reel number
Contents
Dates of records
Date of processing

5.4 Labeling

Each roll of film that is being deposited with the Security Copy Depository must be placed in an enclosure that is labeled with the following information:

Name of agency or political subdivision.
Record series title.
Roll number or other identifier.
Identification of roll contents and/or
Dates of records.
Date of processing.

The first three items must appear on a label at the top of the container as well as on the label on the front of the container. All labeling information must be typed or printed on the labels. Labeling information should never be handwritten directly on the microfilm container.

The chemical makeup of labels may cause microfilm to deteriorate. Labels used on long-term or permanent film should pass the Photographic Activities Test. *Note: See ANSI/AIIM MS6-1981 Microfilm Package Labeling*

5.5 Storage of Security Film

The proper storage of security microfilm is necessary to ensure that the film will last for the life span (retention period) of the records. The Security Copy Depository of the Archives Division satisfies all of the following requirements. The services of the Security Copy Depository are available to state agencies and local governments.

5.5.1 Storage Housing

Microfilm can be stored on shelves, racks, or in cabinets. Like the cores and containers all storage housing must be made of non-corrosive materials. Microfilm must never be stored on or near shelves made of wood or particle board. Highly plasticized resin finishes and lacquered surfaces should be avoided as well.

5.5.2 Storage Environment

There are several environmental conditions that must be controlled in the storage area: relative humidity, temperature, light, and pollutants.

Relative Humidity and Temperature
The retention period of the records determines the relative humidity (RH) temperature in the storage area. Short to medium-term film (a retention period of less than twenty years) should be stored in a storage area where the RH is between 20% and 50%. Long-tem film should be stored in a storage area where the RH is between 20% and 30%.

The RH in the storage area should never vary more than 5% during any 24-hour period. High RH levels can cause mold to grow and attract insects and pests. Low RH levels may cause film to become brittle and crack.

Data loggers and/or a hygrometer can be used to monitor relative humidity in the storage area.

Temperature
Like relative humidity, the temperature in the storage area is determined by the retention period of the records. When short to medium-term film is being stored the temperature should ideally be below 68 F. It should never exceed 77 F. The temperature for long-term film must never exceed 70 F. Low-temperature storage improves the stability of both the film base and the image.

The temperature in the storage area shouldnever vary more than five degrees during any 24-hour period. If the temperature is too high the speed of chemical reactions increases, leading to deterioration.

Data loggers and/or a thermograph can be used to monitor the temperature in the storage area.

Light
Light creates heat, which increases the rate of chemical reactions within the microfilm. Lighting in the storage area should be kept to a minimum.

Pollutants
The storage area should be isolated from any other work area and have an independent circulating system to keep the air as clean as possible. The air should also be filtered to remove impurities such as sulfur dioxide, hydrogen sulfide, ammonia, and solid particles like dust. Silver film must never be stored in the same room with diazo or vesicular film since off-gassing can occur.
Food and drink, and of course smoking, must never be allowed in the storage area. House cleaning, including vacuuming, should be done on a regular basis.

5.6 The Security Copy Depository

Security microfilm of Oregon public records can be stored at the Security Copy Depository (SCD) operated by the Archives Division. The SCD is a media vault designed to store approximately 250,000 reels of microfilm in a secure archival environment. It is located on the second floor of the Oregon State Archives. The services of the SCD are available to Oregon State agencies and local governments.

In order to be accepted into the Security Copy Depository, long-term (100 years or more) and permanent microfilm must meet certain national standards. These include the requirements that the film is made of high quality silver-halide; that it has received polysulfide treatment; and that each reel contains no more than six splices. The film must also come in a 16mm, 35mm, or 105mm roll format. Each roll must be sent in an inert acid-free plastic container. Unitized microfilm formats such as microfiche are not accepted for storage in the SCD.

Any microfilm that is submitted to the SCD with a retention period of less than a hundred years must meet the same requirements as long-term and permanent film, but is not required to be treated with polysulfides.

The security microfilm stored in the SCD is generally only accessed in order to return film to a vendor or the agency for duplication. Duplication costs are paid by the agency.

The SCD provides government officials with the knowledge that key records can be replaced in the event of a disaster. If you are interested in having your agency's security microfilm stored at the SCD please call, 503-373-0701 ext. 255.

5.7 User Copies

Alhough it is not necessary to hold user copies of microfilm to the same standards for storage and handling that security copies are held to, by following the guidelines for storage and handling of security film you can maximize the life of your user copies.

5.8 Inspection of Stored Film

Quality control inspections of stored microfilm must be performed to determine if any deterioration is taking place. These inspections should take place every other year. A system of random sampling must be designed that inspects 1/1000 of the collection or at least 100 reels.

The initial inspection is visual. Signs of deterioration include blemishes, fogging, fungus, brittleness, discoloration, adhesion, and fading. If deterioration is found to be taking place within a group of microfilm an immediate inspection of all the microfilm in that group must take place, and possibly an inspection of the entire collection. Damaged film may be saved through duplicating or treating with cleaning materials such as trichloroethylene

All inspections should follow the standards stipulated in *ANSI/AIIM MS45-1990: Recommended Practice for Inspection of Stored Silver-Gelatin Microforms for Evidence of Deterioration.*

5.9 Vinegar Syndrome

Vinegar Syndrome attacks the base of acetate film when it is stored in elevated temperatures and humidities. Since older acetate films have a life expectancy of only 100 years the number of Vinegar Syndrome cases is growing.

Vinegar syndrome is often recognized by the vinegar smell of the film. This occurs when the film degrades and acetic acid is released. Small strips of specially treated paper, called A-D strips, will also indicate if Vinegar Syndrome is taking place. These strips are left in the film container for a few days. When they are removed changes in the color of the paper will indicate if Vinegar Syndrome has taken place and how severe it is.

The effects of Vinegar Syndrome cause film to shrink, curl, and become brittle. Acidic fumes that escape from the film can cause the breakdown of other microfilm reels in the storage area. Because of this, microfilm with Vinegar Syndrome must be removed from the storage area immediately. The information lost to Vinegar Syndrome cannot be recovered, but the film may be saved by duplication onto polyester film or storage at colder temperatures.

5.10 Reduction Oxidation

Reduction Oxidation (redox) occurs when acidic gasses or excessive humidity attack the silver content of the microfilm. The source of these gasses may be any of the following:

The film itself, if it has been incompletely or improperly processed and washed.

The containers or enclosures in contact with the film, including spools or boxes made from acidic materials.

Improper handling of the film, if the film has been touched with bare hands.

Airborne pollutants circulating through the storage area because of poor ventilation.

Redox often occurs first on the high-density dark areas of the film and on the film's leader and trailer. The blemishes that occur during redox are usually red, brown, yellow, or orange in color. A high concentration of blemishes may appear silver or mirror-like, especially when viewed under reflected light. A blemish is sometimes twenty times smaller than a single letter of text.

Once redox has begun it cannot be reversed. The blemishes will result in the permanent obliteration of the affected images.

5.11 Polysulfide Treatment

In order to protect film against redox the Archives Division requires that before any long-term (100 years or more) or permanent film is submitted to the Security Copy Depository (SCD) it must be treated with polysulfides.

Polysulfide treatment is a process developed by the Image Permanence Institute, which enables film to resist redox. During this treatment film is immersed in a polysulfide solution. The solution reacts with the silver content of the microfilm so that the silver is converted from a reactive silver to an inert silver sulfide. The inert silver significantly increases the film's resistance to acidic gasses, peroxides, and other oxidizing agents.

Polysulfide treatment can be performed during processing or as a post-production procedure. The more opaque (dark) film is the less effective the polysulfide treatment will be. When older film receives polysulfide treatment as a post-processing procedure it will take longer to dry than film that receives the treatment during processing.

If an agency submitted long-term or permanent microfilm to the Security Copy Depository before polysulfide treatment became mandatory, they will be contacted by the Archives Division and the film will be returned for treatment. All long-term microfilm sent to the Security Copy Depository must be stamped or labeled to indicate that polysulfide treatment has been performed.

Micrographics vendors in Oregon that provide polysulfide treatment include:

ACS: 503-239-0570
Image Graphics: 203-926-0100
Integra: 800-444-8688, 208-336-2720
Linco Micro-Image, Inc.: 800-234-7096.
linco@pacinter.net
Technichal Imaging Systems: 360-567-1260
www.tisimaging.com

5.12 Disaster Preparedness

Having a plan for the protection and recovery of microfilm in the event of a disaster is critical part storage. Disaster can strike as a pest infestation or a water pipe rupture or it can come in the form of a fire or earthquake. Of course, not all disasters can be avoided, but having a disaster plan can reduce your risk of disaster and increase your ability to recover your microfilm if one strikes.

A disaster plan should be broken down into four steps, where some of the factors to consider include:

Risk Assessment
Consider the location of your storage facility in regards to natural or industrial hazards. How well built and equipped is your storage facility to deal with a natural disaster such as a flood, fire, or earthquake?

How secure is your storage facility against unauthorized personnel?

Where is microfilm stored in relation to flammable materials or plumbing?

Prevention
Conduct regular building inspections. Check roofs, drains, wiring, etc.

Equip the storage facility with a non-water fire suppression system, such as a carbon dioxide system. Include fire alarms, smoke detectors, and fire extinguishers.
Install emergency lighting.

Store microfilm at least six inches off the ground.

Identify personnel with access to the storage area with security badges. Install alarms and store confidential records in vaults or safes.

Preparedness
Establish salvage procedures, prioritizing the most important records.

Develop a disaster response team. Identify key personnel and the role they will play if disaster strikes. Make sure these people can be contacted 24 hours a day.

Make sure that the resources needed to deal with minor disasters are close at hand. These would include mops, buckets, sponges, flashlights, walkie-talkies, and plastic sheets.

Create a list of consultants, vendors, suppliers, and agencies that will be able to assist you if a disaster strikes.

Have a map of the shutoff points for water, gas, and electricity.

The best way to protect your microfilm in case of a disaster is having duplicate copies stored at an off-site location.

Response and Recovery

Always put human safety above the safety of the records. If a major disaster occurs the fire department or police will determine when it is safe to enter the building.

Locate and establish a recovery site.

Determine which records can be salvaged.

Maintain the security of the building.

Make a written and photographic record of the events.

Note: Microfilm is highly susceptible to water damage. Wet microfilm must be removed from its container and unrolled for air-drying. If microfilm cannot be dried immediately it must be immersed in clean cold water to remove dirt and other debris. Wet microfilm should never be salvaged through freezing or freeze-drying. This will result in the layers of the microfilm becoming separated.

5.13 Destruction of Microfilm

Once records have reached the end of their retention period they should be destroyed. When a vendor is used to destroy microfilm containing confidential information a staff member of the agency should witness the destruction. Recommended destruction methods include incineration, shredding, and dump site burial.

Security microfilm stored in the Security Copy Depository will be returned to the agency at the end of its retention period. The microfilm will be accompanied by a Records Deaccesion Form that must be signed and returned to the Archives Division.

Section 6: Standards

All Oregon State agencies and local governments using micrographic or digital imaging systems as part of their records management program must adhere to the appropriate Oregon Administrative Rules and the standards of the American National Standards Institute and Association for Information and Image Management.

6.1 Oregon Administrative Rules

The Oregon Administrative Rules (OAR) relating to microfilm are 166-025-0005 and the Oregon Administrative Rules relating to digital imaging are 166-017-0010 through 166-017-0080.

The OAR's for microfilming can be found in Appendix __ of this manual and at the Archives Division website sos.oregon.gov/archives. If you have any questions regarding the OAR's call 503-373-0701, ext. 246.

6.2 ANSI/AIIM Standards

The American National Standards Institute (ANSI) and the Association for Information and Image Management (AIIM) are the authority for both micrographic and digital imaging standards. A complete set of ANSI/AIIM Standards should be part of any micrographic program.

ANSI/AIIM Standards can be ordered through the AIIM website, www.aiim.org. A complete listing (updated 2002) of ANSI/AIIM Standards titles can be found in Appendix_.

Glossary

Access - The availability of or permission to use records.

Acid-free - The chemical characteristic of having a pH of 7.0 or greater. Acid-free boxes are used for microfilm storing microfilm.

Active records - Records that continue to be used by the agency that created them for the conduct of regular business and are maintained in active office files.

A-D Strips - Paper strips that change color in acid conditions. They are used to indicate the level of acetic release acid in film that deteriorating from Vinegar Syndrome.

AIIM (Association for Information and Image Management) - A trade and professional organization concentrating on applications of micrographic, optical, and computer technology and systems.
Works with ANSI to provide the quality standards for imaging systems.

Ambient light – Light from a source other than the camera lamps in a filming area.

ANSI (American National Standards Institute) - A U.S. standards organization composed of representatives from industry, technical societies, consumer organizations, and government agencies.
Works with AIIM to provide the quality standards for imaging systems.

AIIM (Association for Information and Image Management) - A trade and professional organization concentrating on applications of micrographic, optical, and computer technology and systems.
Works with ANSI to provide the quality standards for imaging systems.

Aperture card - A card with a rectangular opening into which microfilm may be inserted.

Archival quality - The ability of processed microfilm to retain its characteristics and resist deterioration for a lengthy period of time, generally 100 to 500 years.

Base - The transparent support on which the photographic emulsion of a film is coated.

Book Cradle - A device which holds a large bound book open and flat during filming which a planetary camera.

Certification (Certificate of Legality) - The confirmation that images recorded on microfilm are accurate, complete, and unaltered reproductions of the original records. Sometimes referred to as “Camera Operator’s Certificate.”

Cine Mode - Images of microfilm oriented with information in a sideways position.

Comic - Roll film which reads left to right, as in a comic strip.

Computer Assisted Retrieval (CAR) -The use of a computer created and maintained index to access material recorded on microfilm.

Computer Output Microfilm (COM) - Microfilm containing data converted and recorded directly from a computer.

Confidential information - Information of a private nature that is protected by law from public disclosure.

Contrast - Relationship between light and dark areas of a document or image, described as high, low.

Controls - Practices, tests, and inspections used to ensure the quality of microfilm during filming, processing, and storage.

Cost Analysis - Breaking down the costs of a microfilm program to determine if it will be a cost- effective system for managing your records.

Custody - Guardianship, or control, of records, including both physical possession (physical custody) and legal responsibility (legal custody), unless one or the other is specified.

Density - The light-absorbing or light-reflecting characteristics of a photographic medium.

Density Uniformity - Density levels that meet quality standards maintained throughout a reel of microfilm.

Develop - The process of chemically magnifying a latent image on a film.

Digital imaging system - A system (including people, machines, methods of organization, and procedures) which provides input, storage, processing, communications, output, and control functions for digitized representations of original public records.

Digitization – To put microfilm into digital form.

Disaster plan - The documented policies and procedures intended to prevent, minimize, and recover materials after a disaster.

Duplication - The process of producing one or more copies of microfilm from a master.

Electronic records - Records created by means of a computer and subsequently stored on an electronic storage media and only retrievable through electronic means.

Emulsion (photosensitive layer) - A coating of photosensitive chemicals or compounds carried on a film base.

End-users - Whomever the microfilm is produced to be used by.

Exposure - The act of exposing film to light.

Expungement – The removal, or obliteration, of images from film.

File break - Breaking or ending files at regular intervals, usually at the end of a year or other duration.

File integrity - The principle that completeness, original file order, and unbroken custody of the records in a filing system must be maintained for a record series to maintain legal and intellectual integrity.

Filing system - A set of policies, procedures, and methods used for organizing and identifying files or records to increase their speed of retrieval, use, and disposition.

Files - A term used to describe some or all records and non-record materials of an office or department.

Filing system - A set of policies, procedures, and methods used for organizing and identifying files or records to increase their speed of retrieval, use, and disposition.

Film - Any sheet of transparent plastic base coated with a photosensitive emulsion.

Film Indexing - A system using targets, counters, etc., for locating information on microfilm, precluding the need to examine each image sequentially.

Fixer ("Hypo") - A chemical solution used in processing to remove the undeveloped silver halide from the film and neutralize its light-sensitive property.

Frame - The area of film exposed to light during one exposure.

Generation - One of the successive duplicates of a photographic master. The master is the first-generation film. A duplicate made from the master is a second-generation copy; a duplicate made from the second-generation copy is third-generation, and so on.

Hard copy - A paper copy of the enlarged microfilm image.

Hybrid Information System - An information system that incorporates both microfilm and digital technology.

Image - Any representation of a document or data produced by radiant energy.

Image Marks (Blips) - A rectangular mark recorded below the image on a roll of microfilm used for counting images or frames automatically.

Image Orientation - The arrangement of images with respect to the edges of the microfilm.

Inactive records - Records no longer required by their creating agencies or other agencies to carry on current business and therefore ready for final disposition in accordance with their retention and disposition schedules.

Information Management - The administration, use, and transmission of information and the application of theories and techniques of information science to create, modify, or improve information handling systems.

Information System – A system, whether automated or manual, that comprises of people, machines, and/or methods organized to collect, process, transmit, and disseminate data.

I**nformation Migration –** Transferring information from one medium to another.

I**nspection** – The process during which microfilm is checked and tested to ascertain whether quality standards have been achieved.

Life Cycle – The management concept that records pass through three stages: creation, maintenance and use, and disposition.

Latent image - The invisible image rendered onto photosensitive material by the affects of radiant energy. Development of the material makes the image visible.

Leader - The length of film at the beginning of the reel, prior to any targets.

Life Expectancy (LE) – The number of years information can be expected to be retrieved from microfilm when it is produced and stored under quality standards. The LE of most microfilm is either 100 or 500 years.

Light box - A back-lit translucent surface used for film inspection.

Long-term film - Film suitable for the preservation of records for at least 100 years when stored under proper conditions, providing the film was properly processed.

Long-term records - Records with an approved retention period of 100 years or longer.

Loupe (lupe) - A small, hand-held optical magnifying device used with a light box to inspect microfilm.

Magnification - Enlargement of the microfilm image.

Master (original) - First-generation or camera film, used to produce duplicates or intermediates.

Medium – The material on which information is carried and transmitted by. Ex: Paper, microfilm, cd.

Medium-term film - Film suitable for the preservation of records for up to 100 years when stored under proper conditions and providing the film was properly processed.

Medium-term records - Records with an approved retention period of between ten and 100 years.

Methylene blue test - A test used to measure the amount of residual thiosulphate ion (hypo) remaining on film following washing.

Microfiche - Miniaturized photographic document images arranged in horizontal rows and vertical columns that form a grid pattern on a card-size transparent film sheet. Fiche usually have a title readable without a magnifying device. It is an inexpensive format for published materials large as reports.

Microfilm - A fine grain, high resolution photographic film used specifically for the capture of document images.

Microfilm jacket - A transparent plastic holder approximately the size of microfiche (105 mm x 148 mm) into which individual strips of microfilm are inserted.

Microform - Any form containing greatly reduced images, or microimages, usually on microfilm.

Micrographics - The technology of capturing, storing and retrieving microfiche, aperture card or microfilm-based images.

Negative Image - Film on which the image, or subject appears light and the background appears dark.

Nitrate film - Transparent plastic no longer produced as a film base because it is very flammable.

Needs Assessment - Assessing the needs of your agency and records to determine if a microfilm program will be an effective system for managing your records.

Nonpermanent records - Records which have either limited value or are valuable for short periods of time and will ultimately be destroyed.

Oregon Administrative Rules (OAR) – Include the standards that all microfilm of Oregon public records must meet.

Original microfilm – See master copy.

Permanent film - Film which contains images of permanent records.

Permanent records - Records with a specified retention schedule, which must be kept indefinitely or for at least 100 years for legal, administrative, and research purposes

pH - An organic chemical which in an aqueous solution (or a reasonably humid conditions) changes color dependant on the pH of the water or air. Used as a measure of acidity inside films , in film cans and in atmospheres.

Planetary camera - A type of microfilm camera that photographs a stationary document. The document lies on a plane surface and the camera itself is suspended above the document.

Polarity - The change or retention of the black-to-white relationship of an image. A positive image rendered as a negative image through photography or duplication indicates a change in polarity.

Polyester film - A film base of transparent plastic that keeps its original size and shape, resists tearing, and is strong and relatively nonflammable.

Polysulfide treatment – The process of treating film with polysulfides to protect it against reduction oxidation (redox).

Positive Image - Film on which the image of the dark portions of the subject appears dark and the light portions appear light.

Preservation - The totality of processes and operations involved in the stabilization and protection of documents against damage or deterioration and in the treatment of damaged or deteriorated documents. Preservation may also include the transfer of information to another medium, such as microfilm.

Public Records - As defined in ORS 192, “public record” includes any writing containing information relating to the conduct of the public’s business, including but not limited to court records, mortgages and deed records, prepared, owned, used or retained by a public body regardless of form or physical characteristic.

Processing - The steps necessary to render a latent image visible, usable and permanent (fixed). These steps are development, fixing, washing and drying.

Quality Control - The production techniques and inspections that are used to fulfil the standards required for quality microfilm.

Reader - A device that enlarges microimages for viewing.

Reader-Printer - A device used to enlarge microimages for viewing and to produce a paper of the enlarged image.

Record - A document, regardless of physical form or characteristics, created or received and accumulated by an agency in the conduct of official business.

Record group - A body of related university records that are organizationally grouped together due to their common unit of origin.

Records management - A field of management responsible for the control, maintenance, use, reproduction, and disposition of records.

Records officer - A state agency employee who is legally responsible for coordinating the agency’s records management program with the State Archives.

Records retention schedule - A control document which describes the records of an institution or administrative unit at the record series level, establishes a timetable for the record series life cycle, prescribes an ultimate disposition for the record series, and serves as the legal authorization for the disposition of public records.

Record series - consists of documents or file units arranged according to a filing system or kept together because they relate to a particular subject or function or result from the same activity.

Retention period - The maximum and the minimum length of time that a record must be kept by law.

Retention Schedule - A document that describes agency records, establishes a period for their retention by the agency, and provides mandatory instructions for what to do with them when they are no longer needed for current government business.

Reduction oxidation (redox) - The oxidation of the metallic silver in silver microfilm that leads to blemishes on the emulsion.

Reduction ratio - The relationship between the dimensions of the original document and the dimensions of the microimage of that document.

Resolution - The ability of microfilm or a photographic system to record fine detail.

Resolving power – See Resolution.

Retakes - Refilming of documents.

Retrieval - Finding and making records available from the medium they are stored on.

RFP (Request for Proposal) - a process in which you survey vendors to solicit competitive bids on products and services.

Roll microfilm - Film that is wound on a reel, spool, or core.

Rotary camera - A type of microfilm camera that photographs the document as it is being moved by some sort of a transport mechanism. The document transport mechanism is connected to a film transport mechanism, and the film also moves during exposure.

Security Microfilm - A copy or the original microfilm which is stored under strictly controlled environmental conditions for use as a back-up or duplication master.

Security Copy Depository - The section of the Archives Division which offers storage of security microfilm.

Sign Maintaining – Duplicate film that shares the same polarity as the master copy. A negative makes a negative.

Sign Reversing – Duplicate film that has the opposite polarity of the master. A negative makes a positive.

Silver halide film - Camera film used for microfilming. The silver halide salts form the photosensitive material and image matter of the microfilm. Only silver halide film can be used in a camera for producing a microfilm original.

Splice - The joining of two pieces of film so that they function as one piece.

State Records Center - A facility run by the Oregon State Archives for the low-cost storage and servicing of paper records pending their disposal.

Step-And-Repeat Camera - A microfilm camera that exposes a series of separate images on an area of film according to a set format, usually in orderly rows and columns, such as in a microfiche.

Target, informational - A chart or document which is photographed preceding or following a document or group of documents in order to enhance the usefulness or understanding of the documents.

Target, technical - An aid to technical control of the photographic system which is photographed on the film preceding or following the body of documents.

Transfer - The act or process of moving records from one location to another, especially from office space to agency storage facilities or Federal records centers.

Unitized microfilm - Film that is formatted in discreet units of information, ex: microfiche, jackets, or aperture cards.

Vesicular film - Duplicate film type which forms a latent image when exposed to ultraviolet light and produces a fixed image when subject to heat.

Vinegar Syndrome - The chemical process of film base polymers breaking down to release acetic acid, and causing the base to loose its stability.

Vital record - A record containing information essential to re-establish or continue an organization in the event of a disaster. Vital records comprise the records necessary to recreate the organization's legal and financial status and to determine the rights and obligations of employees, customers, stockholders, and citizens.

Washing - The procedure of passing film through water in order to remove residual process chemicals from the film emulsion and base.

Work copy (User) - A copy of microfilm which is distributed for end use.

Sources

Standards

American National Standards Institute. American National Standard for Imaging Media (Film)—*Silver-gelatin Type—Specifications for Stability*, ANSI IT9.1-1989. New York: ANSI, 1989.

American National Standard for Imaging Media—*Photographic Processed Film, Plates and Papers—Filing Enclosures and Storage Containers*, ANSI IT9.2-1991. New York: ANSI, 1991.

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