State of Michigan
Records Management Services
Best Practices for the Microfilming of Digitized Records

1.0 Introduction

The Records Reproduction Act (MCL 24.401-24.406) regulates the reproduction of public records by Michigan government agencies at all levels. This law allows the Records Management Services (RMS) to promulgate technical standards to ensure the continued accessibility and usability of records that are reproduced throughout their retention period. This document supplements the "Technical Standards for Microfilming Digital Records."

2.0 Scope

This document applies to the conversion of public records by any Michigan public body from digitized format to microfilm for the purpose of maintaining official records in a micrographic format or as a redundancy to an imaging system. If microfilm is produced by a third party, the state agency or local government is responsible for ensuring that the third party is in compliance with these standards.

3.0 Intent

This document is intended to assist state agencies and local governments with ensuring that the records they convert from a digitized format to microfilm are authentic, reliable, have integrity, and are usable. It is not the intention of RMS to impose standards upon a public body that will reduce the intended benefits of the record keeping system. The ultimate criteria are that the records be legible and accessible for their intended use.

In the event that significant deviations from these standards are warranted, the agency should contact RMS to develop technically acceptable alternatives that meet the needs of the agency without the risk of implementing a non-viable or non-compliant solution. In all other instances where deviations from the standards are not required or requested, it is in the best interest of the agency to follow the practices detailed in the standards and best practices.

Some microfilm formats and techniques may not be suitable for long-term retention. Issues that affect the permanent preservation of the records include, but may not be limited to: organization, indexing, format, resolution, and storage media. The Archives of Michigan will work with state agencies and local governments to identify those public records that are designated on an approved Retention and Disposal Schedule for transfer to the Archives for permanent preservation.

4.0 Basic Principles of Record Keeping

Selecting an appropriate record keeping system is like selecting the appropriate level of insurance for your home. Records with a greater value to the agency warrant a greater level of insurance. Records with lesser value "may" warrant a lesser level of insurance. Regardless of the value, all records and record keeping systems maintained by a state agency or local government must conform to four basic characteristics. Records must be authentic, reliable, have integrity, and be usable regardless of the format and the media they are contained on.

An **authentic** record is one that can be proven to be what it purports to be, to have been created or sent by the person purported to have created or sent it, and to have been created or sent at the time purported. To ensure the authenticity of records, agencies and local governments should implement and document policies and procedures which control the creation, receipt, transmission, maintenance and disposition of records to ensure that records creators are authorized and identified and that records are protected against unauthorized addition, deletion, alteration, use and concealment.

A **reliable** record is one whose contents can be trusted as a full and accurate representation of the transactions, activities or facts to which they attest and can be depended upon in the course of subsequent transactions or activities. Records should be created at the time of the transaction or incident to which they relate, or soon afterwards, by individuals who have direct knowledge of the facts or by instruments routinely used within the business to conduct the transaction.

The **integrity** of a record refers to its being complete and unaltered. It is necessary that a record be protected against unauthorized alteration. Records management policies and procedures should specify what additions or annotations may be made to a record after it is created, under what circumstances additions or annotations may be authorized, and who is authorized to make them. Any authorized annotation; addition or deletion to a record should be explicitly indicated and traceable.

A **useable** record is one that can be located, retrieved, presented and interpreted. It should be capable of subsequent presentation as directly connected to the business activity or transaction that produced it. The contextual linkages of records should carry the information needed for an understanding of the transactions that created and used them. It should be possible to identify a record within the context of broader business activities and functions. The links between records that document a sequence of activities should be maintained. The records must be accessible for the duration of the retention period.

5.0 Agency Responsibilities

State agencies and local governments have responsibilities associated with the management of their records and information. These include the following:

- Develop and maintain a **Record Retention and Disposal Schedule**.
- Implement a retention and disposal policy.
- Select an appropriate record keeping system.
- Implement appropriate policies, procedures, and business practices.
- Develop a business analysis to determine whether microfilming will be a cost effective, efficient and durable method of managing records through the retention period of the record.
- Develop a Quality Assurance level of acceptance that confirms that the expectations of the agency are being met.
- Follow specific laws, rules and standards that govern records specific to the industry the records pertain to.

6.0 Standard Operating Procedures

Standard operating procedures should be developed that define the basic processes involved in the production of microfilm from a digitized format.

A standard operation procedure is a document or a collection of documents that defines the way certain functions or processes are always performed. Types of functions or processes may include, but may not be limited to:

- Equipment testing requirements and frequency
- Document preparation functions common to all jobs
- Index data and film backup
- Access and security
- Administration and maintenance
- Audit trails
- Disaster recovery
- Employee safety

7.0 Pre-production Sample for Quality

In order to create a successful microfilm product, the digital images to be converted to microfilm should be created in accordance with the Standards for the Capture of Digital Images from Paper or Microfilm. The standards require that a sample set of source digital images, or digital images equivalent in characteristics to the source documents, be assembled for the purposes of evaluating the microfilm results against defined quality criteria. The results of the pre-production sample will dictate the necessary steps to be taken in the quality control process that is developed.

The purpose of the pre-production sample is to establish a quality reference. It will define what is an "acceptable microfilm image." This quality reference should be maintained for the duration of a project or until a new quality reference is defined. This process allows the end user to continuously evaluate and ensure that the film conversion process is successful as it provides a base upon which to compare future filmed images. The standards require a new sample for quality be performed if the conditions or attributes of documents to be scanned change or if the equipment used to scan the documents change. This process is particularly important when using external service providers, and when the content and quality of documents within a collection vary.

8.0 Quality Control

Quality control processes should be implemented for each application to be microfilmed. The standards require the quality control criteria be established based upon the results of the pre-production quality sample.

Quality control is defined as those steps incorporated into the production process that are designed specifically to reduce error. Quality criteria may include, but may not be limited to:

- Overall legibility
- Smallest detail legibility captured

- Completeness of detail
- Dimensional accuracy compared with the original
- Completeness of overall image area
- Density
- Image skew
- Image orientation
- Index data accuracy
- Image and index format compliance

Once the quality criteria for the various attributes are defined for the production process, procedures should be established to insure that these criteria are met.

9.0 Quality Assurance

State agencies or local governments should implement necessary quality assurance processes for each application. The standards require written quality assurance procedures for inspection. Successful implementation of these procedures will help ensure that the records remain usable throughout their legally-mandated retention period.

Quality assurance is the process by which the total product is examined to insure that the quality criteria initially established in the pre-production test are met. The purpose of this quality assurance process is to establish sampling plans and procedures to inspect the individual attributes of the created product. Upon receipt of a microfilm product the state agency or local government should check to make sure microfilmed documents match the expectations defined by the sample set. Verification is needed to ensure that the attributes that were agreed upon at the onset of the project were successfully delivered.

Keep in mind that there is a significant difference between those quality control steps provided during the microfilm conversion process that are designed to detect and correct errors and quality assurance which is designed to verify the validity and accuracy of the overall delivered product. While the microfilm conversion process should provide quality control prior to product delivery, the end user should also perform its own quality assurance in order to verify that the delivered work product is acceptable.

In order to establish a meaningful sampling process there are three categories of information that should be established prior to the initiation of the production process. These categories can be derived from the sample set. To have a successful process the end user must:

- Identify the specific attributes of the work product that are critical to them
- Establish the Acceptable Quality Level (AQL) expressed as a percentage
- Establish a batch size expressed as a number of the items that are contained within the batch

From this information an inspection model can be developed that will, within the limits of the acceptability level, assure the state agency or local government that the delivered work product meets the established standard. The specific attributes that need to be defined are those elements of the microfilm that are determined to be critical to the overall success of the conversion process. In a production environment, it is not sufficient to simply say, “This is a good image.”

Objective criteria that define what a good image is must be established so that the production process can routinely and reliably produce the defined "good image." Attributes must be defined objectively. Subjective attributes cannot be measured reliably. Be careful to select attributes that are critical to the desired output.

The end user quality assurance process must be performed in a timely manner in order to conform within agreed upon acceptance terms. Quality assurance should be performed before the original imaged documents are destroyed.

Additional information regarding establishing a statistical sampling model can be found in ANSI/AIIM TR34-1996 – Sampling Procedures for Inspection by Attributes of Images in Electronic Image Management (EIM) and Micrographics Systems (as amended or replaced).

10.0 Statement of Work

A statement of work (SOW) should be developed for each record collection or record type to be microfilmed.

The SOW defines the necessary tasks, film formats and product deliverables of a given job set. The SOW should include but not be limited to:

- Definition of current environment
- Definition of the desired result
- Document preparation requirements and instructions
- Documented results of the quality control sample
- Index attributes
- Definition of the camera type
- Definition of the film type and dimensions
- Definition of the record sequence
- Quality control processes

11.0 Operational Practices

One of the significant benefits of the various microfilm formats is that their creation, use and management is supported by reasonable, practical and time tested processes and procedures that are designed to ensure that, when practiced, will result in reliable and dependable products. For purposes of defining the standards by which the microfilm should be created, the following items should be understood. By practicing these standards, the agency will ensure that the microfilmed version of the record is authentic, reliable, and usable and will maintain its integrity throughout the established retention period. There are several general practices that are critical. These are:

1. For records maintained on roll microfilm, only one record series should be permitted on each roll of film.
2. For permanent records, a security roll should be stored in an offsite area.
3. The security roll of film should not be used for any purpose other than to create a new duplicate.
4. The original documents may be destroyed only if all requirements for the creation of the original film have been met.

12.0 Reduction Ratio

Due to the variety of sizes and types of documents that can be scanned, it is not practical to specify which reduction ratio (scale) should be used when converting scanned images to microfilm. A reduction ratio should be selected that is capable of producing legible images. The standards require the characteristics of the record, the tasks the system is designed to perform, and the user requirements to be satisfied be taken into account when selecting a reduction ratio.

*Note: in the event that the collection of imaged documents to be transferred to film contain a variety of sizes (such as a combination of engineering drawings and business documents), there may be (a) loss of legibility or (b) cropping of image content. This situation is not acceptable, and measures should be taken to ensure the entire collection is legible.

The reduction ratio is the relationship between the dimensions of an original and the dimensions of the corresponding microcopy. For example, reduction ratio is expressed as 24:1. The degree of reduction should be chosen after considering all of the system requirements. System requirements may include, but may not be limited to:

- Size, line width, quality, and contrast of the characters
- Size and shape of the original documents.
- Number of generations of film to be produced
- Size of film being used
- Size and shape of screen on viewer

A lower reduction ratio will typically provide higher image quality. Tradeoffs exist between image quality, storage density and film usage. If image quality alone is considered, larger images are usually better. A larger image is generally more tolerant of poor quality original documents and other microfilm variables such as density fluctuations, camera vibrations, and resolution loss.

13.0 Image Sequencing

Images on the microfilm should be organized so the records can be accessed in the same way they would if the microfilm had been created from paper systems. The equipment used to create microfilm from digital images places images in the sequence in which they are received, therefore, state agencies and local governments should determine how records will be accessed in the microfilm format and define a proper sequence for the images. The standards require that images on microfilm created from digital images be organized in a manner that facilitates retrieval.

14.0 Blip

At minimum, single level blip marks should be used, even if there is no intention of utilizing them. This may aid the state agency or local government in the future migration of the microfilm images should it become necessary.

Image marks or blips that are used to identify the frame number of each frame on a roll of film. They are created by the camera at the time of the film image conversion, and are used to

facilitate rapid retrieval of items from a roll. Each frame number is uniquely identified by a sequential number on each roll.

15.0 Targets

The following film targets are required by the standards to certify the authenticity of the records being filmed:

Beginning of Roll

- Digital (manufacturers supplied) writer test targets
- Manufacturer's self-test
- Start Target/Certification of Authenticity - Identifies the government unit, record title, date of filming, reduction ratio, operator's name and roll number.

End of Roll

- End Target/Certification of Authenticity
- Manufacturer's self-test
- Digital (manufacturers supplied) writer test targets

Targets at the beginning and end of a roll of microfilm are a part of the bibliographic and technical control. Targets describe the owner of the record, the type of the record, when the microfilm was made, certifies the authenticity of the record, and provide the technical targets used to objectively evaluate the density, resolution and reduction ratio of the film.

16.0 Film Leader/Trailer

The standards require no less than a 3-foot leader of film before the first target of the roll and no less than a 3-foot trailer after the last target of the roll of film.

17.0 Media

17.1 Original (master) Film

The standards require that only polyester based silver gelatin film LE-500 be used.

Selecting the correct microfilm stock is particularly important when the record has long-term retention attributes. Other (older) film stocks may be made of materials that have known deficiencies in their chemical composition that may cause serious problems with respect to meeting long-term retention requirements. A master negative on any other type of film will not be considered to have Life Expectancies (LE) of 500 years.

17.2 Duplicate Film

The standards require duplicate copies for daily use be made if the film is expected to be handled more than 10 times during its lifetime.

One of the significant advantages of the various microforms is the relative ease and low cost of duplication. It is important to note that use of film on a routine daily basis should be performed from duplicate rolls created from the camera original. Evaluation of the need for duplicates should be incorporated into the feasibility and needs assessment process. Duplicate films may be

silver-gelatin film, diazo film or vesicular film. Diazo film is the recommended and preferred type for usage film.

18.0 Density

The three critical density measurements that comprise a properly exposed and processed micrographic image are:

- **D-MAX:** The highest density achieved in an exposed and processed image. D-MAX range shall be from .80 to 1.20.
- **D-MIN:** The lowest density achieved in an exposed and processed image. D-MIN shall not be greater than .06.
- **Base-plus-fog:** The base-plus-fog density of a film that has been processed but not exposed. Base-plus-fog shall not exceed 0.06.

Density measurements must be made using a properly calibrated densitometer. For high volume production, the densitometer should be calibrated daily. A systematic process of monitoring and recording these densities should be performed in accordance with ANSI/AIIM MS23-1998 – Practice for Operational Procedures / Inspection and Quality Control of First-Generation Silver-Gelatin Microfilm of Documents (as amended or replaced).

By definition density is the ability of a photographic object to transmit light. The higher the density, the darker the image (or area of an image) and the lower the density the lighter the image. This is true for all silver original microfilms, and may be true for some types of duplicating films. The concept of density is critical in the creation of microfilm because the images should not be excessively dark, nor excessively light. An objective reference by which density can be measured is needed to ensure that the microfilm images are legible.

19.0 Resolution

Resolution for microfilm created from digital images is controlled at the time of document scanning. The standards require a device used to create microfilm from digital images have a self-test process to ensure that all of the available pixels are consistently available for recording purposes.

20.0 Silver Film Processing

The standards require exposed microfilm to be processed within two weeks of the completion of the image capture.

Processing must be carefully controlled in order to ensure consistent results. Film produced for purposes of managing public records should be processed in accordance with ISO 18901:2002 – Imaging materials – Processed silver-gelatin type black-and-white films – Specifications for stability (as amended or replaced) and ANSI/AIIM MS23-1998 – Practice for Operational Procedures / Inspection and Quality Control of First-Generation Silver-Gelatin Microfilm of Documents (as amended or replaced).

21.0 Residual Thiosulfate

The standards require testing for residual thiosulfates (commonly known as methylene-blue testing) be performed not less than once per week. LE-500 films should contain no more than 0.014 g of thiosulfate ion per m^2.

In normal silver film processing, fixer or "hypo" is used to remove unused silver particles from the emulsion of the film. If left in the emulsion, these silver particles will continue to react and over time begin to alter the appearance of the film. Fixer is a fairly strong basic compound. If left on the film this basic (salty) compound will damage the film image. The fixer must be sufficiently washed from the film in order to reduce the possibility of damage to the film in the future. Residual thiosulfate should be measured using ANSI/NAPM IT9.17-1993 – Photography-Determination of Residual Thiosulfate and Other Related Chemicals in Processing Photographic Materials-Methods Using Iodine-Amylose, Methylene Blue and Silver Sulfide (as amended or replaced). In cases where an outside service provider is processing the film, test results should be submitted weekly. In the event of a failure, all film processed after the last successful test should be recalled, rewashed and retested in order to ensure that low levels of residual thiosulfates reside on the film. This re-washing process must be performed within two weeks of the original film processing.

22.0 Inspection of Newly Processed Film

Newly processed film should be inspected for both major and minor defects. Identification of these defects may lead to the creation of retakes for a given roll or if the defects are indeed major, the entire roll may be rejected. Examples of minor defects would be skewed images, images in a wrong orientation, images that have a folded edge or corner or overlapped images. Minor defects can be categorized as those that can be repaired by recreating and replacing the defected image. Major defects may include a failure to meet minimum density requirements or incorrect start or end of roll targets. Major errors cannot be repaired. Failure to meet minimum requirements is cause to re-film the contents of the roll. All potential defects should be addressed in the quality assurance process to insure that the quality criteria initially established in the pre-production test have been met. For more information regarding inspection of original microfilm see ANSI/AIIM MS23-1998 – Practice for Operational Procedures / Inspection and Quality Control of First-Generation Silver-Gelatin Microfilm of Documents (as amended or replaced).

23.0 Splicing and Retakes

The standards do not allow a roll of film produced from digital images to contain splicing or retakes.

24.0 Film Storage

Under ideal circumstances, properly manufactured, processed and stored polyester based silver gelatin microfilm (LE-500) can be expected to last for as much as 500 years. The conditions required to meet this life expectancy are: (1) the residual thiosulfate levels are sufficiently low, and (2) the film is stored in an environmentally controlled storage facility. An environmentally controlled facility should meet the following minimum requirements:

- The original (or security film) should be stored in a separate building from the duplicate or working copy.
- The storage room must be separate from other types of storage, offices or work areas.

- The storage room must be equipped with a fire alarm system.
- Stored in a constant cool environment with temperatures not exceeding 70 degrees
- The humidity of the storage facility must be maintained at 35% +/- 5%
- Dissimilar films (silver, diazo, vesicular) should not be stored in the same storage container or cabinet.
- Contained in acid free cardboard boxes or inert plastic containers.

For more information regarding storage environment see ISO 18911:2000 - Photography -- Processed safety photographic films -- Storage practices (formerly ANSI/NAPM IT9.11-1993) (as amended or replaced).

25.0 Inspection of Stored Film

As stated in section 24.0 (above), properly manufactured, processed and stored polyester based silver gelatin microfilm (LE-500) can be expected to last for as much as 500 years. However, since stored films may have the possibility of interacting with other films that are of a different generic type (for example, diazo and silver-gelatin), routine inspection is recommended.

Inspections of the microfilm stored in the facility should be routinely performed to determine to what extent reactions that may be harmful to the film are occurring. State agencies or local governments should develop a microfilm inspection program in order to monitor the condition of the stored film. At minimum, each year a random sample of not less than 2% of the total number of rolls stored in the facility should be examined to determine if deterioration is taking place. Each successive year the sampling population should include new rolls stored in the facility and the balance of the rolls not examined in the previous year. Film collections containing older films should be inspected in greater numbers. Guidelines for inspection are available in ANSI/AIIM MS45-1990 – Recommended Practice for Inspection of Stored Silver Gelatin Microforms for Evidence of Deterioration (as amended or replaced).

26.0 Expungement

If expungement is necessary, the standards require the abrasion method. Punching a whole in the image, blotting out the image with any type of ink or marker or by chemically removing the image should not be used so as not to risk damaging surrounding images. Any duplicates in existence should be recalled, destroyed and re-issued. An expungement certificate must be maintained that details the reason for the expungement, the authority to expunge, the date of the original filming and the date of the expungement. The expungement certification should also indicate that the original and all copies have been expunged.

Expungement is the removal or destruction of an image from a microfilm recording. This procedure requires that no record or identification of the documentation ordered expunged remain on the film.

27.0 References

The following standards and recommended practices issued by the American National Standards Institute (ANSI), the Association for Information and Image Management (AIIM), the National Association of Photographic Manufacturers (NAPM) and the International Association for Standards (ISO) may contain additional information that will assist state agencies and local

government with compliance with Michigan law. These publications are available from the Association for Information and Image Management, 1100 Wayne Ave., Suite 1100, Silver Spring, MD 20910-5699, http://www.ansi.org/.

ANSI/AIIM MS6-1981 (R1993) (R1999) – Microfilm Packaging Labeling

ANSI/AIIM MS8-1988 (R1998) – Image Mark (Blip) Used in Image Mark Retrieval Systems

ANSI/AIIM MS14-1988 (R1996) – Specifications for 16 and 35 mm Roll Microfilm

ANSI/AIIM MS23-1998 – Practice for Operational Procedures / Inspection and Quality Control of First-Generation Silver-Gelatin Microfilm of Documents

ANSI/AIIM MS45-1990 – Recommended Practice for Inspection of Stored Silver Gelatin Microforms for Evidence of Deterioration

ANSI/AIIM TR2-1998 – Glossary of Document Technologies

ANSI/AIIM TR34-1996 – Sampling Procedures for Inspection by Attributes of Images in Electronic Image Management (EIM) and Micrographics Systems

ANSI/NAPM IT9.17-1993 – Photography-Determination of Residual Thiosulfate and Other Related Chemicals in Processing Photographic Materials-Methods Using Iodine-Amylose, Methylene Blue and Silver Sulfide

ISO 15489-1:2001 – Information and Documentation – Records Management – Part 1 – General

ISO 15489-2:2001 – Information and Documentation – Records Management – Part 2 – Guidelines

ISO 18901:2002 – Imaging materials – Processed silver-gelatin type black-and-white films – Specifications for stability

ISO 18911:2000 – Photography -- Processed safety photographic films -- Storage practices (formerly ANSI/NAPM IT9.11-1993)