University of Alaska
Imaging Tutorial and Standard

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Document History

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Introductory sections and initial draft of film imaging section.

Draft 2: January 2004

Revisions based upon December 21, 2004 Committee meeting, and first draft of digital imaging section.

Draft 3: January 2004

Revisions in response to the Committee review of Draft 2 on January 21, 2004.

Table of Contents

1 Introduction

1.1 Purpose

This document is intended as an aid to those using the University Imaging Standard Reference Cards, and as a tutorial on imaging concepts.

These two documents are intended to assist University staff in properly applying imaging technology when preserving records and documents. Examples are grading sheets, applications, and financial support documents.

The needs of historic and archival materials and of scientific data are often case specific and are not completely addressed by this document.

1.2 Organization

This document is structured into three sections. The first covers general topics including when the Standards should be applied, general terminology, and how to decide between film and digital imaging. The second section addresses the use of film imaging and the third section addresses the use of digital imaging. Within each use section are covered specific terminology, document preparation, image acquisition, and image storage and maintenance.

The target audience for the Film chapter (3) is either internal microfilm operations staff or those preparing to use outside film service bureaus. As a result, it is highly technical, and attempts to give a complete overview of film creation and maintenance.

The target audience for the Digital chapter (4) is the broader group within the University that may be using digital techniques to capture information. It focuses primarily on capture activities, and assumes a less technical reader.

2 Common Topics

This section provides concepts and terminology that apply to both film and digital imaging, and how to make a decision when or if to use either to preserve University records.

2.1 General Terminology

2.1.1 Imaging

Brightness – A measure of the degree to which a point or area approaches complete whiteness.

Contrast – A measure of rate of change of brightness in an image.
-High contrast implies dark black and bright white content;
-Medium contrast implies a good spread from black to white;
-Low contrast implies a small spread of values from black to white.

2.1.2 Records Management

Record – A document created or received and maintained by an agency, organization, or individual in pursuance of legal obligations or in the transaction of business.

A document that relates to decisions or transactions of the University. A record is information that has been recorded or captured on a given media. Recorded information may be found on paper, audio tape, and computer hard-drives and disks. The record is both the message and the media it is stored on. Once 'declared', it must remain unaltered across time, no matter how many times it is recalled for use.

Administrative value – The usefulness or significance of records to support ancillary operations and management of an organization.

Records having administrative value are generally considered useful or relevant to the execution of the activities which caused the record to be created and during an audit of those activities.

Evidential value – 1. The quality of records that provides information about the origins, functions, and activities of their creator.
2. Law:·The importance or usefulness of something to prove or disprove a fact.

Evidential value relates to the process of creation rather than the content (informational value) of the records.

Fiscal value – The usefulness or significance of records containing financial information that is necessary to conduct current or future business or that serves as evidence of financial transactions.

Informational value – The usefulness or significance of materials based on their content, independent of any intrinsic or evidential value.

Census records have informational value to genealogists long after those records' evidential value as an enumeration of the population for the federal government has passed.

Intrinsic value – The usefulness or significance of an item derived from its physical or associational qualities, inherent in its original form and generally independent of its content, that are integral to its material nature and would be lost in reproduction.

Intrinsic value may include an item's form, layout, materials, or process. It may also be based on an item's direct relationship to a significant person, activity, event, organization, or place. Intrinsic value is independent of informational or evidential value. A record may have great intrinsic value without significant informational or evidential value; records with significant informational or evidential value may have little intrinsic value. The process of copying a document may sufficiently capture its informational or evidential value, but fail to preserve some aspects of the material nature of the original — its intrinsic value — that merit preservation. Hence, documents with significant intrinsic value are often preserved in their original form.

For example, a document written by a famous individual, such as a signature on a scrap of paper, may tell us little about the person. However, the document might have intrinsic value if it were the only surviving specimen of a document written by the individual. The document might have intrinsic value if it were made using a process of historical interest, such as using inks made from flowers.

Legal value – The usefulness or significance of records to document and protect an individual's or organization's rights and interests, to provide for defense in litigation, to demonstrate compliance with laws and regulations, or to meet other legal needs.

Record Type – A single distinct category of record. Examples are financial aid application form, grade report or invoice.

Record Series – A set of related record types with a common retention schedule. Examples are Admission files and Building Construction files.

A group of similar records that are arranged according to a filing system and that are related as the result of being created, received, or used in the same activity; a **file group**; a **record series.**

Archives – 1. The 'non-current records' of an organization or institution preserved because of their continuing value; the term 'archival records' or 'archival materials' signifies any physical medium which is employed to transmit information, such as paper, photographs, audio or video tape, computer tapes or disks, etc.
2. The 'agency or program' responsible for selecting, preserving, and making available archival materials; also referred to as an 'archival agency.'
3. The 'building' or part of a building where such materials are located.

File – An organized unit (folder, volume, etc.) of documents grouped together either for current use or in the process of archival arrangement. Also called a *file unit*.

File integrity – The concept that the accuracy, completeness, and original order of the records in a filing system must be maintained.

Retention Period – The length of time records should be kept in a certain location or form for administrative, legal, fiscal, historical, or other purposes.

Determined by balancing the potential value of the information to the agency against the costs of storing the records containing that information. Retention periods are set for record series, but specific records within that series may need to be retained longer because they are required for litigation or because circumstances given those records unexpected, archival value.

Record Retention Schedule – A document that identifies and describes an organization's records, usually at the series level, provides instructions for the disposition of records throughout their lifecycle. It describes the proper handling of record types or series from creation through potential destruction. It may also include directions to move records from one location to another or from one media to another. The method for making these decisions and the motivation for a specific rule, including regulatory, judicial or business concerns are included.

Examples of retention rules are:

- Keep in office for 2 years; in storeroom for an additional 3 years; then destroy.
- Keep for life of individual plus 5 years.
- Keep for 5 years after case is decided.

Appraisal – 1. The process of determining if materials have sufficient value to be accessioned into a repository.
2. The process of determining the length of time records should be

retained, based on legal requirements and on their current and potential usefulness.
3. Determining the market value of an item; monetary appraisal.

Disposition – Materials' final destruction or transfer to an archives as determined by their appraisal. Records may be transferred to archives in their entirety, or in part by sampling or selection.

Record copy. -- The single official copy of a document maintained on file by an administrative unit of the University. A record copy is sometimes termed the file copy. The record copy is usually, but not always, the original. A record copy may be held by the creating office or another office of record.

Convenience Copy – Copy or copies of a document or file created and maintained for ease of access and reference. A convenience copy is never a record copy, although it may be an audit copy. Convenience copies are frequently encountered in reader files.

Office of origin -- The university administrative unit within which records are created or received and accumulated in the course of its principal activity.

Office of record -- The university administrative unit, which may or may not be the office of origin, that maintains the record copy of a document for the institution.

Record Attributes:

Active Record – Active records are those that are used frequently and therefore are retained and maintained in the office space and equipment of the user.

Inactive Record – Inactive Records are records that are, by definition, accessed infrequently but must be kept. A typical definition of inactivity is a requirement to access the box or drawer one time or less per month.

Vital Record – any recorded data that is essential for the survival of and continued operation of any organization. Typically, vital records represent no more than 5 percent of the information stored, but their value is far greater than the other 95 percent. You need to preserve and protect these records with the highest levels of safety and security to prepare against worst case scenarios. Examples:

- Contracts/agreements that prove ownership of property, equipment, vehicles, products, etc.;
- Operational records such as current or unaudited accounting and tax records, current personnel and payroll records, client account histories and shipping delivery records;
- Current student files;

- Current standard operating procedures (SOPs);
- Produced reports and summaries;
- Software source codes, to include both licensed programs and systems and custom developed applications and registration keys

Current Record – Records that continue to be used with sufficient frequency to justify keeping them in the office of creation; active records.

Permanent record – Any public record that has been determined to have sufficient historical or other value that warrants its continued preservation.

Long-term record – Any record that has an established retention period of more than 10 years.

Medium-term record – Any record that has an established retention period of less than 10 years.

2.2 When to Image

After choosing an appropriate record series for imaging, you must decide when to do it. The choices are to image at the beginning of the life cycle (soon after the creation of the record); to image when the records are no longer used on a regular basis (usually when records are sent to inactive storage); or to image the records as they approach the end of their life cycle and are evaluated for permanent retention or possible destruction. The following paragraphs discuss general guidelines that can be applied to most projects.

2.2.1 Imaging at Beginning of Life Cycle

Occasionally it makes sense to image records soon after the records are created. This situation may apply if there are large quantities of records that need to be referenced often at multiple locations. Under these conditions, it may be cheaper and easier to produce microfilm or a digital file rather than paper particularly if computer output microfilm or electronic report management is a viable option.

Highly active records

By highly active, we mean a record series that is referenced daily.

Records requiring distribution of multiple copies

Often a record is needed at multiple locations or needs to be distributed to the public or to other University offices. Having copies of such records makes distribution easy and inexpensive.

Records produced using computer output microfilm (COM) or stored in an Electronic Report Management System (ERMS)

ERM or COM completely skips the paper step and goes directly from a print file to either a digital computer file or microfilm. This makes it an ideal, low

cost method for distributing these digital files. Payroll and timekeeping records are often produced using COM.

2.2.2 Microfilming When Records Become Inactive

Many record series need to be retained permanently or for many years but receive little active use after a few years and these records are good candidates for microfilming. Typical examples include employment records and student records.

Records with a retention period of more than ten to fifteen years can be stored less expensively on microfilm than on paper. Conversely, at a price of at least $100 per roll, it does not make economic sense to microfilm lightly used records with a life span less than 10 years.

2.2.3 Imaging at the End of the Life Cycle

Often records are imaged at the end of their life cycle, because they need to be kept for other reasons:

Records Identified as Permanent

Sometimes records are identified as permanent during analysis of inventory sheets. These records are good candidates for microfilming as storage space can be greatly reduced and vital records can be protected.

Records With Historical or Research Value

Records with research value are good candidates for microfilming. For some records research value may be obvious, but for other records it may take a careful review of the records. Evaluating potential research value is an important part of caring for records and should be considered for all records before destruction. University staff evaluating the research value of records may want to consult a University Archivist.

2.3 Choosing the Proper Media

Departments attempting to choose between retaining information as paper, on film or as a digital image should conduct a feasibility study. The feasibility study would include the following:

1. A comparative cost analysis of records use, dissemination, and storage in all three forms. Estimating full costs is a complex task. The fault of most cost estimates is that they do not reflect the full operating cost, but overlook major cost components. The major components that should be included are:
    a. Supply costs.
    b. Labor costs
    c. Equipment costs - purchase (or lease) of equipment and necessary accessories, including workstations, maintenance costs, parts, repairs, etc.;

d. Document preparation cost
e. Miscellaneous costs
f. Service bureau costs
g. Increased work load cost, inflation trends, and technological change.
h. Cost to maintain the records over time, including copying required to address media degradation.

2. The condition of the original records. If the originals are in poor condition, imaging may not be cost effective. Imaging can be an effective preservation tool, but the condition of the original records will determine whether the result is readable, and therefore, whether imaging is feasible.
3. A proper indexing system is essential no matter which approach is used, to permit specific records to be found in a timely and low-cost manner.
4. A plan must be devised for meeting all immediate and long term needs.

Some guidelines for alternatives to examine are:

- A department should consider filming:
    - long-term retention data (more than 10 years),
    - records that are not updateable, and
    - records having a large quantity of data.
- A department should consider digital scanning to:
    - permit process automation,
    - permit distribution or sharing using the Internet or internal systems, or
    - if records will not be needed more than 10 years but it is desirable to save space.

    If scanned documents will be needed for more than 10 years, a film version may be generated from the digital files.
- Paper should be kept (even if copies on other media are made) if there is:
    - archival or historic importance to the originals,
    - regulations or legal decisions require keeping paper originals, or
    - the cost of imaging is not justified.

The feasibility study may disclose problems with current paper record keeping systems that should be corrected whether or not the department decides to convert to an alternative form.

2.4 Destroying the Paper

Once imaged, it may be possible to destroy paper originals, even though the destruction interval on the record has not been reached. However, the following issues should be addressed before destruction occurs:

1. The image quality, completeness and conformance to industry standards has been checked.
2. Standard records management issues such as holds due to pending investigations or legal actions do not exist.
3. There exist no historic or archival reasons to keep the originals.

3 Film Imaging

3.1 Purpose of this section

This section is intended to assist records custodians in creating and storing microfilm and microform records. It is intended to ensure the creation and preservation of acceptable permanent microfilm copies of records scheduled for permanent retention or to substitute for non-permanent records that are being filmed after which the originals will be destroyed.

The primary focus of this section of the Standard is on the use of film to preserve long-term or permanent records. A section (3.11) is provided which addresses the less stringent requirements of filming medium-term records.

3.2 Film Basics

Microfilm is fine grain, high-resolution photographic film capable of recording images. It was developed at the start of the Twentieth Century and was refined and used heavily during World War II. This mature document technology continues to evolve and currently is seeing a resurgence as a component of many hybrid imaging systems.

The process of actually putting the image on film is relatively easy. A camera takes a picture of a document. The camera negative is developed and duplicated. The film is viewed on a reader that magnifies the image. However, to produce quality microfilm that is readable, properly identified, easily accessible, and meets the technical standards is not a simple process. One must be prepared to spend time during the entire process, from selection and preparation of the records to be filmed, through the final inspection and distribution of the microfilm.

Originals are typically on paper, however, it is possible and increasingly common to see digital images and computer print streams converted to film for long-term or permanent retention.

Microfilm produced to preserve long-term records is typically made using a silver emulsion archival master, from which is made duplicate masters, and then copies for actual use are taken from the duplicate masters. This creates an archival master which is rarely handled, and duplicates which experience any wear and tear.

Film cameras are differentiated by the feeding mechanism they use. Planetary cameras keep the paper flat and take a complete picture. Rotary cameras move the paper and the film similar to a copier machine, which makes them subject to errors due to slight inaccuracies in the relative movements.

Care must be taken that the images captured are properly focused and have high contrast to ensure readability. Additional images are added to each reel or card to permit indexing, locating a specific frame, or later checking for media

degradation. Special tests are recommended to make sure that chemicals used in preparing the film do not remain, since they can cause later damage.

Film must be stored in appropriate conditions to prevent damage, and inspected periodically to detect any aging.

Refer to the Terminology topic at the end of this section on film (3.15) to explain any terms used in the following discussion.

3.3 Deciding on Filming

How does one decide on using film to preserve records?

3.3.1 Record Management Benefits of the Micrographic Format

Film shares a number of benefits with digital scanning (Chapter 4):

- **Storage Space Reduction**
  Records reduced to microfilm occupy as little as 2% of space required for the original paper documents. A space savings of 98% could be realized through microfilming.
- **Ease and Speed of Retrieval**
  Miniaturized information can easily be stored in the working office and can be accessed faster by microfilming than by most other methods such as accessing paper stored in file rooms or stored off-site. Digital readers allow the retrieved image to be directly faxed to an off site recipient or distributed to one or more desk tops through the organization's area network.
- **Security of Information**
  The most certain way to ensure the physical security of vital or archival information is to duplicate the source record and store a copy at a secure remote site. If microfilm is designed for long-term retention, the security copy or camera master must be on a polyester based film with a silver gelatin emulsion film and stored under strict security and environmental conditions to ensure preservation and continued usefulness.
- **Cost Savings**
  Microfilming could yield significant savings in reduced on-site and off-site storage costs for records having a long term retention (more than ten years), or records having high retrieval activity. These considerations must be factored into the feasibility study discussed in section 2.2. Other cost savings include reduced storage equipment requirements, enhanced file and record security, and increased flexibility and productivity in office arrangement and information management.

Film also has some unique advantages over paper and digital imaging:

- **Required Retention**
  Film is the ideal media for records that need to be kept permanently or at least for a very long time (decades). Examples are academic records or

workman’s compensation records. Film can be usable for hundreds of years, is not subject to technological change and may be read without requiring technology.

- **File Integrity/Control**
  Once a file has been filmed, its constituent records are locked in place in the order and condition in which they were sent to the camera. Alteration of the file is difficult and the retention of a master film copy at an offsite location acts as a backup ensuring that any tampering will be detected. The built-in protection against misfiling can be a standard feature of any microfilm system.
- **More Durable than Original Document**
  Prior to implementing the program, the records selected for filming need to be examined and evaluated. The questions that need to be asked are "What are the size, condition, and color of the documents, and how well will they reproduce?" Documents that are in poor condition may be reproduced on microfilm to preserve the original documents. Two questions that need to be asked are "Do the records need to be repaired?" and "Can microfilm be considered?" These points must also be included in the feasibility study.

3.3.2 Disadvantages of Microfilming To Consider

- **Microfilming can be very expensive.**
  Labor, equipment, and supply costs must be evaluated against long term storage and retrieval costs of the original documents.
- **Difficult to Change.**
  Once the medium is adopted, it may be difficult to change to a new system.
- **Process Delay**
  Delays and other disadvantages are inherent in the serial document-sequence of micrographics. Each microfilming application should be preceded by analysis to determine if there is good reason to film.

3.4 Preparing Documents for Filming

3.4.1 Preparation of Originals

The following points relate to preparing paper originals:

- All staples, paperclips, pins and attachments must be carefully removed prior to document filming. When using a rotary camera, attachments and documents that are smaller than 3" x 5" should be removed and taped to an 8.5” x 11" piece of white paper.
- Only when using a rotary camera are tattered or torn documents to be mended to eliminate camera malfunction, filming errors and to protect the original public records against further damage. ***This does not apply to***

valuable historical documents. These should be mended only with the advice from a professional conservator. Please contact a University Archivist for assistance in evaluating your documents.

- To eliminate creases or fold in documents, they should be flattened or taped with transparent tape to eliminate shadows, risk of damage to the document or camera malfunction. ***Do not use tape on valuable historical documents***.
- Pages located in a notebook binder should be removed for filming provided that they may be replaced without damaging the book. Sewn books must be filmed in such a manner so as not to break or destroy the binding.

The following points relate to preparing digital originals:

- Examine the images to ensure that they have adequate visual quality, including contrast, brightness, de-skew and image cleanliness like speckle removal and line enhancement.

3.5 Organization

Documents being placed on film should be organized in a standard fashion that is logical and permits easy location of information. In addition, standard test images should be included.

- Documents should be arranged and filmed in a manner consistent with their customary reference and usage unless specified by the record custodian. If there is an index to the record series it should be filmed with the records. When there is no usable order to the records, the responsible department's staff should establish a new arrangement, as they know the records better and have the legal responsibility to manage the records. When verifying the records for order and completeness, the staff should insert targets, identifying problems such as missing pages, faded documents, and damaged documents.
- Purging unnecessary documents, using the appropriate records retention schedule, can dramatically reduce the cost of a microfilm project. As staffs examine files, duplicate records may be found that can be discarded. Also, there is a tendency to shove items into files that have nothing to do with official records and these items should be purged. If a record series is well organized and only a few duplicates are found, it is less expensive to film all the records than pay a staff member to look for the occasional duplicate. Also, it may not be worthwhile to purge small record series. When staff is not available to do the purging, using former employees who are familiar with the records may be an option. Purging of records is almost always undertaken by the responsible department. They have the legal responsibility to maintain the records, and a vested interest in the preservation of the records.

- Images located on roll film, including the user's copy, should contain all of the significant record detail shown on the originals.
- The film images of the records should be arranged, identified and indexed so that any individual document or component of the records can be easily located.
- Film targets should be added (see section 3.6.1 following).

3.6 Non-Document Information

3.6.1 Targets and Titles

Targets are part of the technical and bibliographic control. They are simple images with information concerning either the material filmed, or the method of filming that are added to the document set for inclusion.

When filming paper originals:

Targets should be produced on a computer and then printed with a laser printer or high quality ink jet printer for best legibility. Target originals should be replaced on a routine basis because they become soiled.

When filming digital originals:

Targets can be inserted in the image stream or produced automatically by the filming system. Legibility is important.

The following list identifies commonly used targets:

1. Roll Number – Identifies the roll.
2. Start, End and Defect targets – Should be eye-legible on the film without magnification.
3. Credit – Should have the name and address of the originating agency producing or sponsoring the film.
4. Title page – Should identify the record series being filmed. A record series is a grouping of records physically because they relate to a particular function, such as case files, vouchers, or employee personnel files.
5. Resolution target - Is important in measuring the quality of the system used to produce the film. It consists of five 1010A resolution charts mounted on a large support in accordance with *ANSI/AIIM MS111-1994*. Prepared targets are also available from several suppliers. Photocopies of the technical target must never be used.
6. Uniform density target - Required in preservation microfilming. It is a clean, uncreased, white bond paper or posterboard large enough to fill the frame for whichever reduction is being used. It is used to ensure that the density is uniform across a frame.

7. Certificate of Authenticity - Should state that the records contained on the roll of films are exact copies of the original records and are complete. A signature of the appropriate authority must be included. This documentation is necessary for legal verification.
8. Flash - Allows the viewer to scan the film and easily locate a specific file by alerting that the next target will contain the specific file title.
9. Secondary title - Should identify the specific file, volume, or data span that is to be filmed. In the case of personnel files an example would be the "File of Jones, John."
10. Documents - Should be followed by a flash and a secondary title for each new file or volume filmed within the roll.

The photographic images at the beginning of each roll of microfilm shall include:

a. Information identifying the originating department and organization to which the records relate,
b. The title of the records,
c. The microfilm roll number,
d. The inclusive dates, names, or other data identifying the first and last records on the roll, and
e. Any indexes, registers, or other finding aids for the records on the roll.

If the microfilm is to be used in evidence, appropriate certifications are required at the beginning and end of each roll. To ease roll identification, it is recommended that the title target be re-filmed at the end of the roll of film.

Any indexes, registers, or other finding aids essential to the locating and using records should be microfilmed and located in a readily identifiable place together with the corresponding collection of microfilmed records.

3.6.2 Blip Codes

Blips are opaque marks placed on the microfilm by the camera to mark each one of the several thousand exposures on a roll of 16mm film. Many readers or reader-printers read the blips and wind the film to the exact document that needs to be viewed. This is a great convenience and also reduces retrieval time. Usually there is no charge for placing these blips on the film. Therefore, it is worthwhile to have them even if there is no immediate need to automate retrieval.

3.6.3 Frame Numbering

Most 16mm cameras place a frame number next to each image on the microfilm. Databases can be created to link frame numbers, roll numbers, and file name, social security number, surname or other unique information. Sometimes these projects are completed using previously purchased general database software.

This improves access without expending resources for special retrieval hardware and software, but does not provide complete automated retrieval of records.

3.7 Film Settings

This section addresses the film media issues involved in microfilming.

3.7.1 Leader

Each roll of film should have a minimum of eighteen inches of blank leader and trailer for convenience in duplicating and threading the microfilm reader.

3.7.2 Film Stock

3.7.2.1 Master Copies

The film stock used to make photographic or microphotographic copies of permanent records shall be safety-based permanent record film as specified in American National Standards Institute **ANSI/NAPM IT9.6-1991 (R1996), Specifications for Safety Photographic Film; ANSI/NAPM IT9.10-1996, Imaging Materials - Photographic Film and Paper - Determination of Curl; ANSI/NAPM IT9.8-1994, Imaging materials Photographic Film - Determination of Folding Endurance.** Only polyester-based silver gelatin type film is acceptable for preservation filming that conforms to **ANSI/NAPM IT9.1-1996, Imaging Materials - Processed Silver-Gelatin Type Black and White Film - Specifications for Stability**. A master negative on other types of film will not be considered LE-500 (archival).

3.7.2.2 Duplicates or Use Copies

Security duplicates should be made in accordance with ANSI Standard IT9.5, Ammonia Processed Diazo Films or IT9.12, Processed Vesicular Film.

3.7.3 Width

There are three standard widths of microfilm:

- 16 millimeter (used for typical document filming, and the University's standard)
- 35 millimeter (used for large document filming, such as engineering drawings)
- 105 millimeter (used for microfiche production)

3.7.4 Thickness

Microfilm can be 2.5 to 7 mils thick. Five mils is the industry standard. The thickness of the microfilm determines the strength and the number of images on each roll. A 16mm, 215 foot, 2.5 mil roll of microfilm contains about 5,000 images. A standard 16mm 5 mil, 100 foot roll contains 2000-2500 images. A standard 100 foot, 35mm roll film is 5 mils thick and records up to 1,000 images.

3.7.5 Image Orientation

Records can be filmed in either a "comic" or a "cine" mode. In the comic mode records are arranged on film from left to right like a comic strip. In cine mode images are arranged with bottom of one image above the top of the next as on movie film.

Image orientation is usually dependent upon the size and proportions of the documents. Horizontal images would tend to be filmed in comic mode. In the 16 mm mode, comic mode allows for the most images per roll of microfilm.

3.8 Optical Issues

This section discusses the optical issues involved in filming.

The integrity of the original records shall be maintained by insuring that the microfilmed copies are adequate substitutes for the original records and that they serve the purposes for which the original records were created or maintained. To insure this:

3.8.1 Density

This is the numerical measurement of the contrast between the image and the non-image background of the microfilm. Density is important because it affects the legibility of the microfilm. Faded documents normally have a low density reading (i.e., .075) and high-contrast printed documents normally have high density readings (i.e., 1.2). The photographic densities on negative microfilm shall be at the lowest level commensurate with intended use. Where possible, the delta densities on negative copies shall be as follows:

a. Background densities on negative-appearing camera microfilm.
   Gross background densities from 0.80 to 1.50 in clear-base, negative appearing film are recommended depending on the type of original document and on the reduction. Groups 1 to 5 indicate the density range at which these documents likely can be microfilmed successfully.

   (I) Group 1. High-quality, high contrast printed books, periodicals and black typing. Density of 1.3 to 1.50.

   (II) Group 2. Fine line originals, black opaque pencil writing and documents with small, high-contrast printing. Density of 1.15 to 1.40.

   (III) Group 3. Pencil and ink drawings, faded printing and very small printing, such as the footnotes at the bottom of a printed page. Density of 1.0 to 1.20.

   (IV) Group 4. Low-contrast manuscripts and drawings; graph paper with pale, fine-colored lines; letters typed with a worn ribbon; and poorly printed, faint documents. Density of 0.80 to 1.0.

   (V) Group 5. Although not a general practice, some poor-contrast documents may require a background density of 0.70 to 0.85.

b. The base-plus-fog density of unexposed, processed, clear-base film shall not exceed 0.10. When a tinted base film is used, the density will increase by 0.1 or 0.2, which must be added to the 0.10 value.

c. The ultimate density criteria are for the microfilm to be legible for its intended use, for example, reading, duplicating or printing hardcopies, and for all images in a roll to be duplicated at the same duplicator exposure.

3.8.2 Reduction Ratio

This is the size of the original document compared to the size of the microfilm image, expressed as a ratio: for example, 24 to 1, or 24:1, or 24x. The reduction ratio depends on the size of the original document and the microfilm format. The reduction chosen should produce an image on the reader approximately the size of the original document. The smallest reduction ratio for any microfilm application generally produces the best quality microfilm.

3.8.3 Resolution

This measures the ability of the microfilm to record detail. Resolution is expressed in lines per millimeter and is read from a resolution chart filmed with every roll of microfilm. High resolution readings (five and above on the resolution chart) indicate quality microfilm. Resolution requirements are dependent upon the reduction ratio being utilized. The following is the recommended minimum resolving power (line pairs per mm.) for each reduction ratio:

Reduction Ratio	Line pairs per mm
8:1	80
12:1	108
15:1	106
16:1	114
17:1	107
20:1	112
21.2:1	119
24:1	120
28:1	126
30:1	135
33.9:1	136
36:1	144
42.4:1	136
48:1	134

3.9 Quality Control

3.9.1 Inspection

The final step in assuring the integrity of a film is to perform a frame by frame inspection for visual defects and missing targets. It is important to determine that each document is legible and nothing is missing prior to destroying the original

documents (refer also to section 2.4). For large volume applications, frame by frame inspections may not be possible. A sampling strategy must be developed, i.e. inspect every ten frames for non permanent records and conduct a frame by frame inspection for permanent records.

3.9.2 Retakes and Splicing

When retakes are required, a certification target must be filmed before the records that are to be taken and must be eye-legible on the film. There should be a target at the beginning and end of the retakes.

Splicing must also meet stringent standards to insure the legal status of the microfilm as an official copy of the original records. There should be no more than eight splices or four spliced segments on a roll of film. Refer to **ANSI/AIIM MS18-1992 (R1998) Micrographics - Splices for Imaged Microfilm-Dimensions and Operational Constraints.**

3.9.3 Chemical Residues

Film used for microphotographic copies of permanent records shall be processed so that the residual thiosulfate concentration will not exceed 0.14 micrograms per square centimeter. The test used for determining the concentration of residual thiosulfate on processed film shall be those specified in American National Standards Institute (ANSI) standard IT9.17, Standard for Photography (Chemicals) - Residual Thiosulfate and Other Chemicals in Films, Plates, and Papers - Determination and Measurement.

3.10 Use of Microfilm

3.10.1 Distribution Format

The use copies of microfilm are referred to as the "distribution" copies. These copies can be distributed in a variety of formats as discussed below.

3.10.1.1 Open roll

Open roll is a continuous length of microfilm wound around a spool. This form is the least expensive to create, easy to distribute, and is used because a large amount of information can be stored on one roll. Also, roll film is commonly used for storage of the master negative. File integrity can be guaranteed in the roll format as it is impossible to alter the film without creating a visible splice. Therefore roll film format is ideal for records that may be involved in legal or administrative proceedings.

3.10.1.2 Cartridge

A cartridge is a roll of microfilm placed in a special plastic case. This form requires special retrieval equipment but does protect the microfilm from dust and fingerprints. Cartridges can be quickly loaded into a computer-assisted retrieval

system (CAR). Many of these systems automatically advance the film to the document that needs to be referenced.

3.10.1.3 Aperture cards

Aperture cards are cards in which a rectangular window has been cut and frames of microfilm are placed. Aperture cards are most commonly used for large engineering drawings. To insure the legality and the longevity of the microfilmed records, the camera negative (silver gelatin master) should be maintained in a roll format and stored off-site under strict environmental controls.

3.10.1.4 Microfiche

Microfiche (105mm) is produced using a step and repeat camera or from Computer Output Microfiche (COM).

3.10.1.5 Jacketed microfiche

Jacketed microfiche is 16mm or 35mm film strips that are sleeved in polyester jackets. Usually one jacket can contain up to 60 images. There is a space at the top of the jacket for indexing that enhances retrieval. This form can be updated as new records are created. The equipment used for retrieval is relatively inexpensive but jacketing microfilm is expensive because of the time it takes to cut and sleeve the microfilm. **Never jacket silver gelatin master negatives.** Using jackets compromises the file integrity because film can be removed from the sleeves. Often, inexpensive duplicate microfiche are made for distribution from the jacked microfilm.

Because of the significant labor and materials costs associated with jacketing microfilm, use of this format should be given careful scrutiny. Jackets can be used to merge both 16 and 35 mm formats to allow better access to complex record series. For example, a building department file can have the plans put into 35mm jackets and the associated letter/legal size documents put into 16mm jackets, and then have the two types interfiled. This gives the benefits of both formats, but is the most expensive way to microfilm. Sometimes microfiche are used to mange case files such as student files, a building file, or personnel records. A simple index printed on the top line of the microfiche provides efficient access to the records. Microfiche can be read using inexpensive readers.

3.10.2 Copies

The camera master should not be used for reference purposes. The camera master should be stored offsite at a secure, environmentally controlled vault or other facility. Adequate measures shall be taken to keep the original microfilm clean and unscratched.

A printing master (second negative) should be produced from the camera master for making necessary additional copies.

Third positive or third negative shall be used for reference purposes. Reference copies may be silver, vesicular, or diazo When a department finds that the reference copies are deteriorating, a copy should be made from the printing master (second negative).

3.10.3 Storage and Maintenance

3.10.3.1 Packaging

The following standards are to be observed in packaging silver original microfilm copies of permanent and long term records. The standards shall also be applied to silver duplicate microfilm to assure maximum protection against deterioration:

1. *Reels and Cores*
   Microfilm stored in roll form shall be wound on cores or on reels of the type specified in **ANSI/AIIM MS34-1990, Dimensions for Reels Used for 16mm and 35 mm Microfilm**. The materials used for the cores and reels shall be non-corroding such as plastic compounds or non-ferrous metals. The use of steel core reels shall be permitted provided the reels are well protected by lacquer, enamel, tinning, or other corrosion-resistant finish. Plastics and lacquers that might give off reactive fumes or exhumations during storage shall not be used. The plastic materials must be free of peroxides.
2. *Fastenings*
   Paper strips which have not been deacidified or rubber bands shall not be used for fastening film on reels or cores. The materials used shall not ignite, decompose, or develop reactive fumes and vapors. Button and string ties, in accordance with **ANSI NAPM IT9.1-1996 and ANSI IT9.11-1993**, are standards for securing film on reels in preservation microfilming.
3. *Storage Containers*
   The microfilm shall be stored in a closed container made of such inert material as metal, plastic, or acid-free paper in accordance with **ANSI/NAPM IT9.2-1991 and ANSI/NAPM IT9.11-1993**. The container shall be sealed when necessary to maintain prescribed humidity limits or to protect the film against gases and impurities. If proper temperature and humidity controls are maintained as prescribed in section 3.10.3.2 and if there is good ventilation and clean air in the storage area, the containers need not be sealed. Open containers such as folding cartons may be used only if it has been established that the container material is acid free and will have no adverse effect on the film over long periods of time.

   Storage containers should be properly identified by originating department, record series, date filmed, and name of producer. This will help to identify films if problems develop later. All film boxes must have noted on them the reduction ratio, resolution, density, and base fog readings of the film contained therein.

3.10.3.2 Storage

The following standards are applicable to the storage of microfilm copies of permanent and long-term records:

1. *Room*
   The microfilm is to be kept in a fire resistant vault or room. The storage area is not to be used as an office or working area. No flammable materials shall be stored in the storage area. For full protection against exposure to fire and associated hazards, fire resistive safes or insulated containers shall be placed within fire resistive vaults or rooms constructed in accordance with recommendations of the National Fire Protection Association standard NFPA 232.
2. *Humidity and Temperature*
   The relative humidity and temperature of the storage vault or room shall be maintained at a constant level. Optimum levels are below 21 Celsius for temperature and between 20% and 50% for humidity according to ANSI/NAPM IT9.11. 1993. Rapid cycling and wide ranges of humidity or temperature shall be avoided and shall in no instance exceed plus or minus 5 percent humidity or plus or minus 5 degrees F. temperature in a 24-hour period. Where inactivity of the film permits, protection may be increased by conditioning and sealing the film at a lower temperature. Moreover, a lower temperature can compensate for a higher humidity, but the maximum humidity shall not exceed 50%. Film stored at humidities below 20 percent and temperatures below 21 degrees Celsius shall be sufficiently warmed and reconditioned before using to avoid damage in handling.
3. *Protection against Impurities*
   Adequate measures shall be taken to keep the original microfilm clean and free of scratches. The film should be free from fingerprints and other foreign materials. Gaseous impurities as sulfur dioxide and hydrogen sulfide that may cause deterioration of microfilm shall be removed from the air.
4. Solid particles that abrade film or react on the image shall be cleaned from the air supplied to microfilm storage and associated rooms by the use of dry media mechanical filters or electrostatic precipitators.
5. Air conditioning shall be kept under sufficient control to meet the standards for temperature and humidity as specified above. Dehumidifiers employing inert desiccants may be used provided the humidifier is equipped with filters capable of removing dust particles down to 0.3 micrograms per square centimeter in size and is controlled to maintain the relative humidity. Water trays or saturated chemical solutions shall not be used to increase the humidity level because there is serious danger of over humidification.
6. Silver-gelatin microfilm shall not be stored with other types of film in the same room or in rooms connected by ventilating ducts because gases given off by the non-silver gelatin microfilm may damage or destroy the safety-film base.

3.10.3.3 Microfilm Inspection

At approximately 2-year intervals, a 1 percent sample of randomly selected rolls of microfilm shall be inspected. For each biennial inspection a different lot sample shall be chosen, allowing some overlapping of inspection to note any changes in previously inspected samples. If film is stored with a service bureau reports should be requested that include (1) quantity of microfilm of permanent records on hand, i.e. number of rolls, microfiche, jackets, etc.; (2) quantity of microfilm inspected; (3) condition of the microfilm; and (4) corrective action required, if necessary.

A number of different representative samples of film shall be inspected at 2 year intervals. If deviation from recommended temperature and humidity has occurred, inspection shall be made at 1 year intervals. For each biennial inspection, a different lot sample shall be chosen, allowing some overlapping of inspection to note any changes in previously inspected samples. Guidelines as set forth in the **National Bureau of Standards Handbook 96, Inspection of Processed Photographic Record Films for Aging Blemishes** shall be followed.

3.11 Standards for filming medium-term public records.

This section addresses the relaxed requirements when filming medium-term (under ten year retention) records.

1. Records to be retained less than 10 years may be microfilmed in accordance with University requirements for the retention of the records, including the option of using any film, processing system, or storage containers the department may select.
2. Storage standards for medium term microfilm - Temperature and humidity of medium-term storage areas shall be maintained in accordance with **American National Standards Institute (ANSI) standard NAPM IT 9.11**. Walls and enclosures shall be so designed to prevent moisture from condensing on surfaces when exterior temperatures are below the dew point. Inspection and viewing of medium term film may be done in the same area - separate work and storage areas need not be maintained, but good housekeeping practices shall be followed. Separate storage rooms shall be maintained for films that release acid fumes.
3. Cost benefit analysis - Before records with a retention period of less than 10 years are committed to microfilm, a cost benefit analysis shall be prepared to insure that the project or system contemplated is cost effective.

3.12 Digital to Film

3.12.1 Image to Microfilm

Film from image systems, such as the Kodak Imagewriter®, which produce original permanent and long term records on microfilm with no paper originals

shall be designed so that the resulting microfilm product meets applicable standards set forth in this section. The following issues are of particular concern:

- Organization of the images into a logical and complete set by series.
- Inclusion of targets.
- Original image quality

3.12.2 Computer Output to Microfilm

Computer Output Microfilm (COM) systems, which produce original permanent and long term records on microfilm with no paper originals shall be designed so that the resulting microfilm product meets applicable standards set forth in this section.

3.13 Profiles

We provide the following profile for the most typical filming operations at the University:

3.13.1 Office Documents

REDUCTION RATIO: Maximum 32x.

BACKGROUND DENSITY RANGE, CAMERA FILM: 0.80 to 1.20, measured as visual diffuse transmission density in accordance with ANSI PH2.19. Background density applies to all images.

BASE PLUS FOG (Dmin): Dmin shall not exceed 0.08.

RESOLUTION: Minimum resolution 5.0 test pattern, at the maximum reduction ratio used for this project. Resolution must be read from corner to center to corner in all directions, on all test charts.

CAMERA FILM: 16mm x 100 feet x 5mil thick, non-perforated, polyester, high-contrast (gamma 3.0 to 4.0) panchromatic film preferred. Film shall be in accordance with ANSI IT9.1.

IMAGE ORIENTATION: comic or cine mode, whichever yields lower reduction ratio.

FILM STABILITY: All silver gelatin film shall be monitored for stability in accordance with ANSI IT9.1. A sample of clear film shall be subjected to the methylene blue test, procedure 2 (high range thiosulfate) for residual thiosulfate ion, in accordance with ANSI PH4.8 (re ANSI IT9.1, table 4, 0.14 g/m2 max.). The test shall be performed by an independent test laboratory, subject to the approval of the department. Each processor employed for this project shall be tested once weekly, preferably when the microfilm covered by these standards is processed. The original test certificate shall be mailed directly to the department. The stability of the film is tested by sampling; therefore, failure of the test will require refilming all microfilm in the untested batches that precede and follow the failed sample.

TARGETING AND SEQUENCE:

a. Clear leader, 24" minimum

b. START target (eye-legible)

c. ROLL NUMBER (eye-legible)
*(**b.** and **c.** above may be combined into one target)*

d. Contractor's name and address (or Internal camera operator), date filmed, reduction ratio, film manufacturer, type, expiration date and batch number

e. Certification target signed by the camera operator

f. Declaration by records custodian
*(**d.** through **f.** above may be combined into one target)*

g. Density target: the optimum density target is a full-frame image, using blank paper that matches the record in color and reflectance density. Every effort should be made to use a blank sheet from the actual record. In the event this is not available, a clean, blank, color-matched 20-pound bond sheet may be substituted

h. Resolution target: **ANSI/AIIM MS51**, or equivalent

i. Residual thiosulfate test certificate: A copy of the certificate precedes the filming date by a maximum of two (2) weeks (one week preferred)

START RECORDS

j. Indices and finding aids precede the documents, if supplied by the originating department or added by vendors. *START FILE* target shall be used to separate individual existing folders when specified.

k. Defect targets indicate defects to records as appropriate. Typical targets: *DAMAGED DOCUMENT, MISSING DOCUMENT, POOR QUALITY DOCUMENT*, etc.

END OF RECORDS

l. Density target (same as **j** above)

m. Resolution target (same as **k** above)

n. Residual thiosulfate test certificate (same as **l** above)

o. ROLL NUMBER, eye-legible

p. END target, eye-legible

q. Clear trailer, 24" minimum

The complete microfilm specifications for this project, including these Standards, shall be filmed at the beginning of the first roll of this records series. In the case of an ongoing filming program, the specifications will be microfilmed at the beginning of the first roll of the year, whether calendar or fiscal.

IMAGE SPACING: 10mm (also known as "pulldown," this is the distance between corresponding points on two successive frames).

RETRIEVAL AIDS: Image marks ("blips"), in accordance with ANSI/AIIM MS8, shall be provided for all 16mm roll film applications.

(The following requirement shall not apply when roll film is reformatted into jackets, or when the documents are pre-numbered and when this numbering system shall be used for retrieval). Sequential frame numbers shall be provided, starting with 1 (or 0001) at the beginning of each roll (including the identification target), and shall continue sequentially through the roll without variation. The last frame number shall be equal to the number of frames on the roll.

JACKETS: (this paragraph applies only to jacket systems).

Warning
First-generation silver gelatin microfilm (camera film) shall not be jacketed.

a. **Indexing:** Jacket indexing shall be machine-printed, 10 pitch, dense black opaque characters (fifty-three characters and spaces maximum). There shall be 1/4" minimum clearance to both edges. All letters shall be capital letters. Characters shall be vertically centered in the index space within .03".

b. **Format:** Overall size: 105mm x 148mm, as per ANSI/AIIM MS11, with five 16mm chambers.

c. **Loading:** Insert film with sensitized side in contact with the thin wall (contact sheet) of the jacket. Film strips shall have a minimum clearance of 5mm (1/8") from both edges of the jacket.

d. **Target jackets:** Identification and inspection targets (paragraph 11) shall be inserted into jackets in roll number sequential order, one roll per jacket chamber. Target jackets shall be delivered in separate envelopes with the associated jacket delivery.

SPLICING: Splices shall comply with ANSI/AIIM MS 18.

a. Only ultrasonic-weld splices shall be used.

b. There shall be no more than two splices per 100 foot roll.

c. Splicing shall be placed only in the clear leader at the beginning of the roll.

d. Targeting described above shall be reproduced in the retake, with the exception that the Start Target shall read *START RETAKE*, and End Target shall read *END RETAKE*.

e. Splicing technical targets is prohibited.

FILM DUPLICATES

The maximum allowance of resolution loss on the duplicate shall not exceed one pattern from the camera original.

Diazo (best for reader service use).

a. Base: polyester, 4.0mil thick

b. Size: 16mm x 100 feet or 16mm x 130 feet (for microfiche or jackets: 105mm X 148mm x 5mil thick)

c. Bar-gamma range: 1.10 to 1.49

d. Dmax range: 1.50 to 1.80

e. Dmin range: burn-out density plus 0.05 to 0.09. Example: typical burn-out density of 0.05 should result in a Dmin of 0.10 to 0.14

f. Title backing for duplicate microfiche: white.

Silver (should not be used in a reader, only for storage and printing)

a. Base: polyester, (4.0mil thick)

b. Size: 16mm x 100 feet or 16mm x 130 feet

c. Film should be sign maintaining, negative to negative, such as Kodak 2468 and 2470. Sign reversing films, such as Kodak 2462, should not be used unless a positive appearing image is mandatory.

d. Dmin range: 2468 - 0.10 to 0.15; 2470 - 0.15 to 0.25; 2462 - less than 0.16, Dmax = 1.20 - 1.60

EMULSION ORIENTATION: Emulsion shall be oriented as specified in ANSI/AIIM MS 14.

PACKAGING: Silver gelatin camera film shall be on spools as per ANSI PH1.33. Film shall be in closed plastic boxes or acid-free paper suitable for permanent storage as per ANSI IT9.2. Spools shall fit into boxes loosely, without binding or pressure.

Duplicate film copies shall be packaged as follows: all reels in plastic boxes, in accordance with ANSI/AIIM MS 34, the film trailer secured to the hub with plastic trailer holders. All cartridges, in accordance with ANSI/AIIM MS 15

Microfiche/jackets and duplicates, packaged separately, shall be delivered in boxes.

PACKAGE MARKING: The following data, machine-printed on plain white permanent adhesive labels, shall appear on each roll package edge:

MAU/Department
Records Series Title / Date and/or Subject
Film Type: SILVER ORIG. or SILVER DUPL. or DIAZO
Roll Number

Side label data: same as above. The contractor's name shall appear on the package side label, lower edge only, no more than thirty characters; maximum character height 1/16".

DOCUMENT FLATNESS: Folded and rolled documents shall be microfilmed absolutely flat and shadow-free. The bottom surface of each document shall be totally in contact with the camera copy board working surface.

QUALITY OF WORK: Each frame of microfilm shall be exposed and processed so that every line and character on the document appears on the microfilm. Film shall be free of scratches, holes in the emulsion or base, tears, finger marks, or any other defect that might adversely affect quality.

INSPECTION: Each roll of first-generation silver gelatin microfilm shall be inspected for compliance with the requirements herein. As a minimum, each roll of film shall be inspected for resolution, density, processing quality, and general workmanship. An inspection report for each roll of microfilm shall be included in each shipment.

QUALITY CONTROL: Images that, upon inspection, do not meet the requirements of these standards will be defined as defective, and must be refilmed at the contractor's expense. If the number of defective images does not exceed one image in 500 (five images per roll of 2,500 images), the defective images may be filmed as retakes in accordance with SPLICING of these Standards. If the number of defective images exceeds one image in 500, the entire roll must be refilmed.

First-generation silver gelatin microfilm (camera film) shall be delivered for inspection, **before duplication**, to an inspection agent.

Note that certain requirements, such as REDUCTION RATIO; RESOLUTION; SPLICING; etc., apply to the entire roll of microfilm. Should a roll of microfilm fail to meet the requirements described in these and similar paragraphs, the entire roll of microfilm must be refilmed, despite the number of defective images.

REJECTION OF FIRST-GENERATION SILVER GELATIN MICROFILM: When an entire roll of film is rejected by the department or its inspection agent, the rejects may be defaced by punching a clearly defined hole approximately 1/4" in diameter through the microfilm image or *START* target, without deleting the image or unit identification; or the entire leader up to the first frame can be cut from the roll. Rejected film may be retained by the department.

SHIPMENT OF FILM: Film shall be shipped in reusable fiber cases. Recommended case construction:

a. Size (large box): 15" x 12.5" x 4"; nominal inside dimensions' capacity: (42) 16mm rolls.

b. Size (small box): 15" x 8.5" x 4"; nominal inside dimensions' capacity: (28) 16mm rolls.

c. Mail card holder with reversible mailing card for convenient return shipment.

d. Metal reinforced corners.

e. Adjustable cross-straps, two minimum.

The film must be packed so that all edge labels are visible and facing the same direction.

Each film shipment shall include the following:

a. Detailed packing slip, in duplicate.

b. Photocopy of the most recent methylene blue test results.

c. Copy of the film inspection report (see QUALITY CONTROL above).

26.3 Shipment by express service only. The shipment must be insured for replacement costs, payable to the contractor, in both directions.

FACILITIES: Facilities shall be subject to periodic inspection to ensure production and quality control capabilities.

FILE INTEGRITY: Unless otherwise specified elsewhere in the contract, the documents shall be maintained in existing file order before, during, and after filming. File material shall be returned to the original storage containers in the same order that existed before filming. Corrections to file order resulting from preparation for filming shall be maintained in the subsequent refiling. Fasteners (staples, clips, tape, etc.) must be restored.

3.14 Applicable National and International Standards

3.14.1 ANSI

IT 9.1 - 1992 Imaging Media (Film) - Silver-Gelatin Type - Specifications for Stability

IT 9.2 - 1991 Imaging Media - Photographic Processed Films, Plates, and Papers - Filing Enclosures and Storage Containers

IT 9.17 - 1993 Photography - Determination of Residual Thiosulfate and Other Related Chemicals Processed Photographic Materials - Methods Using Iodine-Amylose, Methylene Blue and Silver Sulfide

IT 9.11 - 1993 Imaging Media - Processed Safety Photographic Film Storage

PH2.19 - 1986 Conditions for Diffuse and Doubly Diffuse Transmission Measurements

3.14.2 ANSI/AIIM:

MS08 - 1988 Image Mark (Blip) Used in Image Mark Retrieval Systems

MS14 - 1988 Specifications for 16 and 35 Microfilms in Roll Form

MS18 - 1992 Splices for Imaged Film - Dimensions and Operational Constraints

MS19 - 1993 Recommended Practice for Identification of Microforms

MS23 - 1997 Practice for Operational Procedures/Inspection and Quality Control of First Generation Silver Gelatin Microfilm of Documents

MS42 - 1999 Recommended Practice for the Expungement, Deletion, Correction or Amendment of Records on Microforms

MS45 - 1990 Recommended Practice for Inspection of Stored Silver Gelatin Microforms for Evidence of Deterioration

TR02 - 1992 Glossary of Imaging Technology

3.14.3 Other:

ISO 3334 - 1989 Microcopying: ISO Test Chart No. 2: Description and Use in Photographic Documentary Reproduction

National Fire Protection Association standard NFPA 232.

Y14.2M - 1987 Engineering Drawing and Related Documentation Practices - Line Conventions and Lettering

3.15 Film Terminology

16mm microfilm – microfilm which is 16mm in width, commonly used to film office documents up to 8 1/2 by 14 inches.

35mm microfilm – microfilm which is 35mm in width, commonly used to film documents larger than 8 ½ by 14 inches and often used to film archival records.

Aperture card – a card with a rectangular hole or holes specifically designed to hold a frame or frames of microfilm. Often used to store frequently accessed large format documents such as building plans.

Base – polyester layer upon which the film emulsion is embedded.

Blips – are opaque marks placed on the microfilm by the camera to mark each one of the several thousand exposures on a roll of 16mm film.

Book cradle – equipment used to microfilm bound volumes. The cradle flattens pages to increase sharpness and reduce shadows during filming.

Camera negative – microfilm used in a camera to produce original roll of microfilm. For permanent records the camera negative must have a silver gelatin emulsion to ensure longevity of the film. To minimize damage to the microfilm, the camera negative **is only** used to produce user copies of the microfilm.

CAR – computer assisted retrieval systems. An automated system that uses a database in conjunction with reading "blip" marks on each frame of 16mm microfilm to speed retrieval of documents on microfilm.

Cartridge – is a roll of microfilm placed in a special plastic case. This form requires special retrieval equipment but does protect the microfilm from dust and fingerprints. Microfilm used in CAR systems are housed in cartridges.

Certification – process by which the camera operator and the records custodian document that the microfilm reflects true copies of the records. Following set certification procedures ensures microfilm will be admissible in court or administrative proceedings.

Cine mode – images arranged on microfilm with bottom of one image above the top of the next (like movie film).

COM – computer output microfilm. Microfilm produced directly from a computer file to microfilm. COM produces high quality microfilm, often in microfiche format.

Comic mode – images arranged on film from left to right like a comic strip.

Density – measures the **contrast** between the image and the non-image background of the film.

Diazo microfilm – microfilm used to create user copies of microfilm. This film is ideal for everyday use because of its strength and high quality image. This film has an average life expectancy of 50 years.

Document preparation – activities that must be undertaken to prepare records for filming. Activities include **physical preparation** such as removing staples, unfolding etc. and **intellectual preparation** which includes placing records in the correct order, purging records when appropriate, producing indexes, etc.

Duplicate microfilm - Second generation negative or positive microfilm meeting the requirements of American National Standards Institute (ANSI) standards ANSI/NAPM IT9.1 referenced above, or:

a. ANSI/IT 9.5 - American National Standard for photography (film) - ammonia-processed diazo film - specifications for stability.

b. ANSI/IT 9.12 - American National Standard for photography (film) - processed vesicular film - specifications for stability, whether produced from an original negative or from an original positive.

Emulsion – a light sensitive layer coated onto a film substrate. The microfilm images are recorded in the emulsion layer of the microfilm.

Frame numbering – number placed by most 16mm cameras next to each image on the microfilm.

Jacketed microfiche –is 16mm or 35mm film strips that are sleeved in polyester jackets containing three to eight sleeves.

Leader – clear film 24 to 36 inches on the front and back of the roll of microfilm to protect the images on the film.

Methylene blue test – SEE Residual Thiosulfate Test.

Microfiche – a sheet of microfilm containing multiple images in a grid pattern.

Microfilm – fine grain, high-resolution photographic film capable of recording images.

Microfilm / microfiche readers – equipment used to read microforms and whose primary components include a lens, a light source, and a viewing screen. Microfilm is normally enlarged to original size for reading.

Microfilm / microfiche reader / printers – equipment used to read and produce paper copies of documents from microfilm.

Micrographics – science of recording images on microfilm.

PQIX (Picture Quality Image Exchange) -- Records information about the scene being photographed on a thin magnetic layer on the back of the film and optically on the emulsion. PQIX also allows photo finishers to include information such as date, time, and titles on the back of your photographs.

Planetary cameras – camera consisting of a camera head (with the film), lights, and a copy board. Documents are placed under the camera head and filmed while lying flat on the copy board.

Polarity – microfilm has either a negative polarity (white lettering on a dark background) or a positive polarity (black lettering on a light background). Original camera film normally has a negative polarity.

Reduction ratio – how may times a document is reduced in size during microfilming expressed as a numerical value. A reduction radio of 24X means the document was reduced 24 times during microfilming.

Residual thiosulfate test – test used to measure chemical residue left on microfilm after processing.

Resolution – measures the ability of the microfilm to record fine detail (sharpness of an image).

Resolution target – target used to read resolution of each roll of microfilm. The target must comply with the American National Standards Institute standard published as ANSI/AIIM MS51.

Rotary camera – a camera into which documents are fed and the documents and the film move simultaneously similarly to the way a photocopy machine operates. These cameras are used for high speed filming that produces low quality microfilm.

Serialized microforms – microfilm where images are stored sequentially on a roll.

Silver original microfilm - Camera microfilm meeting the requirements of the American National Standards Institute (ANSI) standards:

a. ANSI/IT9.6 - American National Standard for photography (film) - safety photographic film.

b. ANSI/NAPM 9.1 - American National Standard for photography (film) - archival records, silver-gelatin type, with a base of safety cellulose ester and polyester having silver-gelatin emulsion.

c. ANSI/IT9.10 - American National Standard for photography (film) - methods for determining curl.

d. ANSI/NAPM IT9.7 - American National Standard method for determining the brittleness of photographic films and papers.

Specification – a written document that details the technical requirements for a microfilming project.

Splice – a joint made by welding two pieces of film together so they will function as a single piece when passing through a microfilm reader. Splicing is used to correct errors and should only be done in the clear leader at the beginning of the roll of film.

Target – information microfilmed preceding or following documents to supply bibliographic or technical information.

Unitized microforms – images are cut or created in units and are housed in jackets or are created as original microfiche. Often used in case file applications because each individual case file can be contained on one or more microfiche.

Vesicular microfilm – microfilm used to create user copies of microfilm. This duplicating film is sometimes preferred because duplication process does not require the use of chemicals.

4 Digital Imaging

4.1 Purpose of this section

This section is intended to assist University personnel to create usable digital images of documents and forms. It is intended to ensure that the digital images are usable substitutes for paper documents when automating processes and can permit the destruction of originals.

The primary focus of this section is for casual users of digital scanners and the creation of raster images.

This document only addresses the area of graphics, paper document images and photographs when used to store University records. It does not seek to address the special requirements of historians and archivists or medical imaging.

4.2 Digital Imaging Basics

4.2.1 Digital Images

There are two styles of digital images: raster and vector. A raster image represents the original into a sequence of rows of points. The density of the representation, expressed as dots or pixels[1] per inch, and the range of values used for each point determine the accuracy of the raster image. Vector representations convert each geometric shape on the page into a mathematical representation. This Standard only addresses raster imaging.

4.2.2 Digital Capture Devices

4.2.2.1 From Paper

There are a number of different devices that can produce digital images. Those designed to capture from paper include:

- Scanners:
  These devices are built specifically to generate digital images. A digitizing mechanism (scanning head) is moved relative[2] to the paper and captures a row of pixels at a time.
- Facsimile machines:
  Facsimiles transmit the image of paper sheets to a corresponding device where it is usually printed out. Unlike scanners and most other digitizing devices, facsimiles do not encode their images with

[1] Abbreviation for Picture Element.

[2] In some scanners the head moves and the paper stays motionless; in others, the paper is moved past a stationary head.

square pixels. (Refer to “square pixels” in the terminology section for more explanation.)

- Multifunction devices:
  These are combination facsimile / printer / copier / scanner devices.
- Digital copiers:
  Some paper copiers use digital technology to capture and produce the copy (versus optical technology).

The paper is presented to the capture mechanism either manually or through some feed mechanism that uses either pinch rollers or belts. Paper scanning devices can capture one side (simplex) or both sides (duplex) at the same time.

Scanning devices are rated based upon:

- The number of pages that can be fed through and captured per minute.
- The number of pixels or dots per inch than may be captured
- Physical and image error detection and correction features.

Selecting a scanner should be based upon the quantities of the paper to be scanned, the qualities of paper, and the time constraints for obtaining the digital image. Many individuals may have occasional needs to digitize a few sheets of standard weight (16 to 24 pound) paper, printed and written in dark inks on white. This can easily be addressed using an inexpensive manual feed desktop sheet scanner or a multifunction like a digital scanner.

Areas receiving large quantities of time-critical documents including carbon-less forms and hand-written originals should consider larger production scanners with automatic feeders, miss-feed detection and automatic image correction logic. Image correction can adjust brightness and contrast, ensure alignment of the image to the perpendicular, remove dust speckles and fill line breaks, eliminating the need for manual correction or rescanning.

Special types of originals may dictate obtaining special scanning hardware, due to the character of the originals (for example, slides or transparencies) or their size (for example, 11” x 17” or larger sizes).

A scanner should be selected in conjunction with the software that will be used to collect the image and permit correction, indexing and capture to the repository. This will ensure that they operate together properly and will permit easy transfer of the images into the internal systems that will use and preserve them.

4.2.2.2 Photography

Digital photography is growing rapidly, and digital cameras are becoming more accurate, as defined by the number of pixels they can capture in a still. Digital cameras capture the complete scene at one time on a photosensitive array, versus one line at a time. Resolution is therefore fixed based upon the number of points in the array.

Standard digital cameras produce their pictures in JPEG format (see next section for explanation) automatically. A few cameras offer the option to save a raster format which may be converted into TIFF or JPEG as desired.

4.2.3 Data Formats

Digital raster image storage has two aspects: encoding and file format.

Image compression and encoding schemes fall into two major categories: loss-less and "lossy". The loss-less formats maintain information on every pixel captured. Examples are LZW (Lempel-Ziv-Welch) compression and the ITU-T (International Telecommunication Union – Telecom Sector; previously known as CCITT) Facsimile group systems. Lossy techniques use approximation techniques to reduce the size of the resulting data file. Examples are the Joint Photographic Experts Group (JPEG) Compression, and the different Motion Picture Experts Group (MPEG) formats. One danger of using lossy compression files is that further information may be lost every time the file is saved. For example, if one opens a JPEG image in a picture editing tool, rotates it and then saves it, the clarity will be less than the original.

File formats dictate how the encoded image is placed into a data file. Some formats support a number of different encoding schemes. Examples are Adobe's Tagged Image File Format (TIFF) and Portable Document Format (PDF). Other formats only support a single encoding scheme, such as CompuServe's Graphics Interchange Format (GIF) (sm), W3C's Portable Network Graphics (PNG), and JPEG File Interchange Format **(**JFIF) files.

Some file formats permit all the pages of a document to be contained in one file; others will only hold a single image.

4.3 Deciding to Digitize

4.3.1 Record Management Benefits of Digital Imagery

Digital scanning shares a number of benefits with filming (Chapter 3):

- **Storage Space Reduction**
  Records reduced to digital occupy virtually no space. As a result, vast space savings can be achieved.
- **Ease and Speed of Retrieval**
  Digital images indexed in a repository may be accessed almost instantaneously by anyone with access rights to the document. Desktop viewers allow the retrieved image to be printed, directly faxed to an off site recipient or emailed.
- **Security of Information**
  The most certain way to ensure the physical security of vital or archival information is to duplicate the source record and store a copy at a secure remote site. With digital imaging, the image may be a backup to the paper

original, or a copy of the image file and indexing information may be copied to a security location.

- **Cost Savings**
  Imaging could yield significant savings in reduced on-site and off-site storage costs for records having a short term retention (less than ten years), or records having high retrieval activity. These considerations must be factored into the feasibility study discussed in section 2.2. Other cost savings include reduced storage equipment requirements, enhanced file and record security, and increased flexibility and productivity in office arrangement and information management.

Digital images also have some unique advantages over paper and film:

- **Ease of distribution and disaster recovery**
  Digital images may be instantly distributed to alternate sites, or easily backed up at little cost.
- **Subject to Different Preservation Concerns**
  Digital images are subject to concerns about media and format longevity but do not age like paper. Digital imaging may also be used to correct for fading, discoloration and other changes in the paper original, producing an image that is more usable than the original.

4.3.2 Disadvantages of Digitizing to Consider

- **Potentially at risk from technology changes.**
  Digital images can only viewed using computer systems. As that technology changes, images may need to be moved or converted so they can continue to be usable. This may be due to obsolescence of the image encoding or format, or media obsolescence.
- **Easy to Change.**
  Digital images can be edited easily with desktop tools. Procedures must be taken to make sure that records are not altered.
- **Security Challenges.**
  By virtue of being easily copied and transmitted, record security can be more difficult to maintain than with physical records.

4.4 Organization of Documents

Documents being imaged should be organized as one document for the imaging repository, in proper page sequence.

- Purging unnecessary documents, using the appropriate records retention schedule, can dramatically reduce the cost of an imaging project. As staffs examine files, duplicate records may be found that can be discarded. There is a tendency to shove items into files that have nothing to do with official records and these items should be purged. If a record series is well organized and only a few duplicates are found, it is less

expensive to image all the records than pay a staff member to look for the occasional duplicate. It may not be worthwhile to purge small record series. When staff is not available to do the purging, using former employees who are familiar with the records may be an option. Purging of records is usually undertaken by the responsible department. They have the legal responsibility to maintain the records, and a vested interest in the preservation of the records.

- Images should contain all of the significant record detail shown on the originals.
- The images of the records should be identified and indexed so that any individual document or component of the records can be easily located.

If capture is to an imaging repository system, then the image file paging option appropriate to the system should be used. Many image repositories store document pages as independent single page files to simplify functions such as annotation and provide better performance, organizing the pages logically.

If images are not being scanned directly into an image repository system, then documents should be scanned into a single multi-page format. This will maintain the order and the completeness of the document for the future. If the document was captured originally in multi-page form there is always the option to later convert it into single pages when importing it to a repository.

4.5 Digitizing Paper

4.5.1 Preparation of Paper Originals

The following points relate to preparing paper originals:

- All staples, paperclips, pins and attachments must be carefully removed prior to scanning. When using a scanner with pinch rollers, attachments and documents that are smaller than 3" x 5" should be removed and taped to an 8.5” x 11" piece of white paper.
- When using a scanner with any pinch roller mechanism, tattered or torn documents should be mended to eliminate camera malfunction, filming errors and to protect the original public records against further damage. ***This does not apply to valuable historical documents***. These should be mended only with the advice from a professional conservator. Please contact a University Archivist for assistance in evaluating your documents.
- To eliminate creases or fold in documents, they should be flattened or taped with transparent tape to eliminate shadows, risk of damage to the document or scanner malfunction. ***Do not use tape on valuable historical documents***.
- Pages located in a notebook binder should be removed for imaging provided that they may be replaced without damaging the book. Sewn books must be imaged in such a manner so as not to break or destroy the

binding. A special purpose scanner may be appropriate for imaging bound volumes.

4.5.2 Capture

When capturing the digital image, image enhancement hardware and / or software should be used. There are a number of options, some of which are only appropriate for special situations. However, the following are recommended:

- Deskew of up to 3 degrees, to correct for slight misalignments during paper feeding.
- Border detection to limit the image area to the edges of the original.
- Automatic contrast and brightness adjustment within plus or minus 20% of the mean.

Periodic maintenance of the scanning device is required. The paper path and optical areas should be cleaned, as paper dust collects. Rollers and belts can become worn or covered in dirt, ink or other substances from the paper. They should be cleaned as needed and replaced when worn, or else there will be an increase in misaligned images and jams.

4.6 Non-Paper to Digital

While most digital imaging originates from paper originals, it is also possible to store images generated electronically or from film.

4.6.1 Cameras

Digital cameras generally produce a lossy JPEG (Joint Photographic Expert's Group) output with a compression of 20:1. A minimum of 2 megapixels is desirable to ensure a quality image. Images are moved between cameras and PC's via cables or through the use of memory cards.

4.6.2 Facsimile

Facsimile machines use a rectangular pixel that can complicate image storage and forms processing. They may also generate resolutions significantly less than produced from scanners. The transmission encoding used in facsimile machines can also introduce image defects for several successive raster lines if there is noise on the telephone connection.

4.6.3 Application produced image files.

If produced with the proper resolution, compression and file format, software-generated images produced from print streams or by special applications can be used. Electronically produced, they are visually perfect, without the errors found in scanned images. They can be introduced directly into the capture process for form processing and indexing.

4.6.4 Film to Digital

Film originals have different preparation issues from paper. One needs to accurately register the image before scanning. Manual registration is unrealistic for production situations and mechanical advancement is subject to error; prior provision of film blips permits the film scanner to position properly for each frame.

Microfilm can be converted to digital images using special scanning equipment. Care needs to be taken to ensure that the film is properly framed and focused. Film blip codes assist in finding and positioning a particular image for the capture device.

4.6.5 Video to Stills

Video streams may also be a source of still pictures. Conversion hardware and software can be used to capture a specific frame of a video stream, and then produce either a JPEG or an RGB raster file. The quality of the resulting picture depends on the quality of the original video and can be reduced by any analog to digital conversions systems.

4.7 Non-Image Files

The original electronic application files produced by software tools can also be stored into an electronic repository. However, with one exception, that is outside the scope of this Standard.

That exception is the Adobe PDF format, since many image capture tools have the option of producing PDF rather than TIFF. PDF has a number of features not found in TIFF:

- A number of security features which permit control of modification, text extraction, and printing.
- Acceptability for use on Internet web sites.

However, PDF is not completely accepted as a format for records. There are a large number of options provided within PDF, questions about how to implement annotations and redactions, and concerns about using a format which is proprietary. Work on an international standard, labeled “PDF/A” (for archive) is currently in progress.

4.8 Quality Assurance

After a digital image is captured it needs to be inspected. Alignment, contrast and legibility need to be checked. Often quality assurance is integrated with indexing the image, either manual or automatic.

Images should be reviewed on a large (17” or greater) high-quality flicker-free screen, which permits clear examination and reduces eye strain. Due to the need to index each imaged document, image sampling techniques are not appropriate. However, if desired, only checking the first page of each document when indexing may be acceptable.

4.9 Forms Processing

Data may be collected automatically from images, both for indexing and as input to data systems. Special software can read both printed and handwritten information from the document and identify its connection to pre-defined data fields.

If possible, the form should be designed to make recognition easier. This involves spacing around and between fields, recognition and registration marks, and the use of input guidance such as letter boxing.

Please refer to the recommendations made in the profile section (4.11.3) for image capture settings appropriate to do forms processing.

4.10 Indexing Information

The indices appropriate to the record series should be captured to the imaging repository or an associated database at the time of imaging. This is the responsible department's task, as they know the records better and have the legal responsibility to manage the records. When verifying the images for order and completeness, the staff should identify problems such as missing pages, faded documents, and damaged documents.

Most digital image file formats only maintain information specific to the characteristics of the image compression. However, a few have provision for indexing information to be included. If available, this feature should be exploited so that the image file is self-describing, and can be identified if separated from the associated catalog.

4.11 Profiles

4.11.1 General Digital Imaging Practice

Please refer to section 4.5.2 for generally recommended scanning enhancement settings. Other options that may be applied for specific document categories are:

- De-speckle
- Line enhancement, both horizontal and vertical

4.11.2 Bi-tonal Documents

This profile is appropriate for a bi-tonal image where the image is only being used to preserve a record for later reference.

Images should be Tagged Image File Format Version 6 (TIFF 6), encoded using the ITU-T Group 4 fax compression technique. If the original is high contrast with large font (9 points or greater), it may be scanned at a 200 by 200 dots per inch. Otherwise, it should be scanned at 300 by 300 dpi. If the image is intended for later conversion to film, a minimum of 300 x 300 dpi should be used.

4.11.3 Forms with Recognition

This profile is appropriate for paper forms that will be processed by OCR and forms recognition systems. It is an extension of the Bi-tonal profile.

The minimum density required for reasonable OCR and forms recognition is 300 dpi by 300 dpi. 400 by 400 dpi may be needed if the font on the form is less than 8 points. The settings used for bits per pixel and density must match those used to train the forms recognition system.

If possible, the form should be designed to make recognition easier. This involves spacing around and between fields, recognition and registration marks, and the use of input guidance such as letter boxing.

4.11.4 Photographs

If scanned, settings should be:

- 35mm Negative and Slide Film should be scanned to achieve pixel dimensions of 1024 X 1536. Pixel dimensions of 2048 X 3072 will likely capture the grain of the film and can be used to create better print reproductions. 24-bit color or 8-bit grayscale should be used depending on the source (color or black & white).
- *Prints*: Resolution requirements will vary, minimum should be 300 dpi. 24-bit color or 8-bit grayscale depending on the original. It may be preferable to scan from negatives if they are available.

The output format if intended for web and general records use is JPEG with a compression of 20:1 to limit file sizes.

If intended for long-term or archival use, an appropriate TIFF raster format should be selected from the specification.

If captured using a digital camera:

- Output should be in JPEG with a compression of no greater than 20:1 to limit file size.
- Information captured with digital photography should include date/time, f stop and resolution.

4.12 Applicable Standards

4.12.1 ANSI/AIIM:

MS44-1988(R1993) Quality Control of Image Scanners

MS52-1991 Requirements and Characteristics of Original Documents Intended for Optical Scanning

MS53-1993 Recommended Practice; File Format for Storage & Exchange of Image; Bi-Level Image File Format

MS58-1996 Standard Recommended Practice for Implementation of Small Computer Systems Interface (SCSI-2), (X3, 131-1994) for Scanners

MS61-1996 Application Programming Interface (API) for Scanners in Document Imaging Systems

TR15-1997 Planning Considerations, Addressing Preparation of Documents for Image Capture

TR19-1993 Electronic Imaging Output Displays

TR17-1989(A1992) Facsimile & Its Role in Electronic Imaging

TR26-1993 Resolution As It Relates to Photographic & Electronic Imaging

TR31 Performance Guidelines for Admissibility of Records Produced by Information Technology Systems As Evidence

- Part 1-1992(R1999) Performance Guideline for Admissibility of Records Produced by Information Technology Systems as Evidence
- Part 2-1993(R1999) Acceptance by Federal or State Agencies of Records Produced by Information Technology Systems
- Part 3-1994(R1999) Implementation of Performance Guidelines for the Legal Acceptance of Records Produced by Information Technology Systems
- Part 4-1994(R1999) Model Act and Rule

TR32-1994 Paper Forms Design Optimization for Electronic Image Management (EIM)

TR33-1998 Selecting an Appropriate Image Compression Method to Match User Requirements

TR34-1996 Sampling Procedures for Inspection by Attributes of Images in Electronic Image Management (EIM) & Micrographics Systems

TR38-1996 Identification of Test Images for Document Imaging Applications

TR40-1995 Suggested Index Fields for Documents in Electronic Image (EIM) Environments

4.12.2 Other:

Tagged Image File Format (TIFF) Revision 6, June 3, 1992

Adobe Portable Document Format (PDF) Reference, Fifth Edition, Version 1.6. © 1985–2004 Adobe ® Systems Incorporated

X440 - Scanner Test Chart Set

4.13 Digital Terminology

(Most definitions below supplied from Kodak Digital Glossary)

1-bit color -- The lowest number of colors per pixel in which a graphics file can be stored. In 1-bit color, each pixel is either black or white.

8-bit color/grayscale -- In 8-bit color, each pixel is has eight bits assigned to it, providing 256 colors or shades of gray, as in a grayscale image.

24-bit color -- In 24-bit color, each pixel has 24 bits assigned to it, representing 16.7 million colors. 8 bits - or one byte - is assigned to each of the red, green, and blue components of a pixel.

32-bit color -- A display resolution setting that is often referred to as true color and offers a color palette of over 16 million colors.

Accelerator -- A device or software designed to speed up operations, such as refreshing a screen image. Many PC SVGA graphics boards come furnished with accelerator chips.
There are also auxiliary boards (commonly called pass-through boards) that will boost the speed of regular VGA boards.

Access Time -- The time required for a data storage device to locate and retrieve data.

Additive Colors -- Red, Green, and Blue are referred to as additive colors. Red+Green+Blue=White.

Aliasing -- An effect caused by sampling an image (or signal) at too low a rate. It makes rapid change (high texture) areas of an image appear as a slow change in the sample image. Once aliasing occurs, there is no way to accurately reproduce the original image from the sampled image.

Anti-aliasing -- The process of reducing stair-stepping by smoothing edges where individual pixels are visible.

Artifact -- An undesirable degradation of an electronic image. Usually occurs during the electronic capture, manipulation, or output of an image.

Aspect Ratio -- The ratio of horizontal to vertical dimensions of an image. (35mm slide frame is 3:2, TV 4:3, HDTV 16:9, 4X5 film 5:4)

Background Processing -- A feature that enables the computer operator to continue working while the computer executes another action, such as spooling data to a printer.

Banding -- An artifact of color gradation in computer imaging, when graduated colors break into larger blocks of a single color, reducing the "smooth" look of a proper gradation.

Bandwidth -- Defines the amount of information that can travel between two points in a specific time.

Binary -- A coding or counting system with only two symbols or conditions (off/on, zero/one, mark/space, high/low). The binary system is the basis for storing data in computers.

Bit -- A binary digit, a fundamental digital quantity representing either 1 or 0 (on or off).

Bitmap -- An image made up of dots, or pixels. Refers to a raster image, in which the image consists of rows or pixels rather than vector coordinates.

Brightness -- The value of a pixel in an electronic image, representing its lightness value from black to white. Usually defined as brightness levels ranging in value from 0 (black) to 255 (white).

Byte -- An ensemble of eight bits of memory in a computer

Calibration -- The act of adjusting the color of one device relative to another, such as a monitor to a printer, or a scanner to a film recorder. Or, it may be the process of adjusting the color of one device to some established standard.

CCITT (Comité Consultatif International Téléphonique et Télégraphique) (Consultative Committee for International Telegraphy and Telephony) – Refer to ITU-T.

CD -- The abbreviation for compact disc, a laser-encoded plastic medium designed to store a large amount of data. A variety of CD formats are available for use by computers.

CD drive -- A drive mechanism for recording or playing CDs. The most common types are CDROM, MO (magneto-optical), and WORM (Write Once, Read Many).

CD-ReWritable Media -- A product on which users can record text, images and graphics for permanent or temporary storage. Because it allows multiple recordings, users can erase and rewrite as often as needed.

CD-ROM (Compact Disc, Read-Only Memory) -- A non-rewritable CD used by a computer as a storage medium for data.

CCD-Charged Coupled Device -- A charged coupled device (CCD) converts light into proportional (analog) electrical current. The two main types of CCDs are linear arrays used in flatbed scanners, digital copiers, and graphic arts scanners, and area arrays used in camcorders, stillvideo cameras, digital cameras, and fast scanners.

Channel -- One piece of information stored with an image. True color images, for instance, have three channels-red, green and blue.

Chroma -- The color of an image element (pixel). Chroma is made up of saturation + hue values, but separate from the luminance value.

Chromatic adaption -- Adjustment to overall color shifts, like those produced by filters.

CMS (Color Matching System) (Color Management System) -- A software program (or a software and hardware combination) designed to ensure color matching and calibration between video or computer monitors and any form of hard copy output.

CMY (Cyan, Magenta, Yellow) -- The three subtractive color primaries.

CMYK (Cyan, Magenta, Yellow, Black) -- One of several color encoding system used by printers for combining primary colors to produce a full-color image. In CMYK, colors are expressed by the "subtractive primaries" (cyan, magenta, yellow) and black. Black is called "K" or keyline since black, keylined text appears on this layer.

Color correction -- The process of correcting or enhancing the color of an image.

Color Wheel -- This is an aid to be used when selecting colors for a harmonious color scheme. You can easily identify and split complementary colors.

Compression -- The reduction of data to reduce file size for storage. Compression can be "lossy" (such as JPEG) or "lossless" (such as TIFF LZW). Greater reduction is possible with lossy compression than with lossless schemes.

Continuous Tone -- An image where brightness appears consistent and uninterrupted. Each pixel in a continuous tone image file uses at least one byte each for its red, green, and blue values. This permits 256 density levels per color or more than 16 million mixture colors.

Contouring -- A visual effect in an image as a result of low brightness resolution which appears as bands of sharp, distinct, brightness change. Very similar to banding.

Contrast -- A measure of rate of change of brightness in an image.
-High contrast implies dark black and bright white content;
-Medium contrast implies a good spread from black to white;
-Low contrast implies a small spread of values from black to white.

Cropping tool -- The cropping tool simulates the traditional method for cropping- that is, trimming photographs.

Default setting – A preset parameter in computer programs which will be used unless changed by the operator.

Densitometer -- A tool used to measure the amount of light that is reflected or transmitted by an object.

Desktop Publishing -- Describes the digital process of combining text with visuals and graphics to create brochures, newsletters, logos, electronic slides and other published work with a computer.

Diffusion dithering -- A method of dithering that randomly distributes pixels instead of using a set pattern.

Digital -- A system or device in which information is stored or manipulated by on/off impulses, so that each piece of information has an exact or repeatable value (code).

Digital camera -- A device that captures an image on a CCD so it can be downloaded to and manipulated by a computer. It might also be called a film-less camera.

Digital Image -- An image composed of pixels.

Digital Zoom -- Allows the user to zoom in on a subject beyond the range provided by the optical zoom lens. Digital zooming crops the center of the digital picture and resizes the new cropped picture to the size of the selected resolution.

Digitization -- The process of converting analog information into digital format for use by a computer.

Disc -- Term used to describe optical storage media (video disc, laser disc, compact disc), as opposed to magnetic storage systems.

Discrete Cosine Transform (DCT) – A lossy compression technique used in creating JPEGs.

Disk -- Term used to describe magnetic storage media (floppy disk, diskette, hard disk), as opposed to optical storage systems.

Dithering -- A method for simulating many colors or shades of gray with only a few. A limited number of same-colored pixels located close together are seen as a new color.

DPI (Dots Per Inch) -- The measurement of resolution of a printer or video monitor based on dot density. For example, most laser printers have a resolution of 300 dpi, most monitors 72 dpi, most PostScript image setters 1200 to 2450 dpi. The measurement can also relate to pixels in an input file, or line screen dots (halftone screen) in a prepress output film.

E-mail -- An abbreviation for electronic mail.

EPS (Encapsulated PostScript) -- A graphic file format developed by Aldus, Adobe, and Altsys to allow exchange of PostScript graphic files (image information) between application programs.

Exif (Exchangeable image format) -- A file format used in digital cameras.

Fiber Optics -- An optical system that uses glass or transparent plastic fibers as light transmitting media.

File Format -- A type of program or data file. Some common image file formats include TIFF, PICT, and EPS.

Filters/Software -- A program that accepts data as input, transforms it in some manner, and then outputs the transformed data. For example, a software program such as PhotoShop can take blurry pictures and filter them to produce a clearer picture.

FITS (Functional Interpolating Transformation System) -- A format that contains that contains all data used to design and assemble extremely large files in a small, efficient mathematical structure.

Flash memory -- A type of memory chip that can retain data after the system has been turned off. Its advantage is that digital cameras with flash memory can have batteries go "dead" and yet retain image data.

FlashPix -- Trade name for a new multi-resolution image file format jointly developed and introduced in June 1996 by Kodak, HP, Microsoft and Live Picture.

Flat Bed Scanner -- An optical scanner in which the original image remains stationary while the sensors (usually a CCD linear array) passes over or under it. The scanned material is held flat rather than being wrapped around a drum.

GIF File Format -- Stands for Graphic Interchange Format, a raster oriented graphic file format developed by CompuServe to allow exchange of image files across multiple platforms.

Gigabyte (GB) -- A measure of computer memory or disk space consisting of about one thousand million bytes (a thousand megabytes). The actual value is 1,073,741,824 bytes (1024 megabytes).

Gray Level -- The brightness of a pixel. The value associated with a pixel representing it's lightness from black to white. Usually defined as a value from 0 to 255, with 0 being black and 255 being white.

Gray Scale -- A term used to describe an image containing shades of gray as well as black and white.

Halftone Image -- An image reproduced through a special screen made up of dots of various sizes to simulate shades of gray in a photograph. Typically used for newspaper or magazine reproduction of images.

Hue -- A term used to describe the entire range of colors of the spectrum; hue is the component that determines just what color you are using. In gradients, when you use a color model in which hue is a component, you can create rainbow effects.

Icon -- A small graphic symbol or picture on a computer screen that represents a file, folder, disk, or command.

ICC(International Color Consortium) -- Established in 1993 by eight industry vendors for the purpose of creating, promoting and encouraging the standardization and evolution of an open, vendor-neutral, cross-platform color management system architecture and components.

Image Pac -- Image Pac is a proprietary file format designed specifically for storing photographic quality images on CD. It is now used in numerous pre-press, scientific and commercial applications

Image Processing -- Capturing and manipulating images in order to enhance or extract information.

Image Resolution -- The number of pixels per unit length of image. For example, pixels per inch, pixels per millimeter, or pixels wide.

ITU-T -- is the telecom standardization organization of the International Telecommunication Union (ITU) and agency of the United Nations. Previously known as CCITT.

IVUE -- A file format associated with FITS technology that enables images to be opened and displayed in seconds by showing only as much data on the screen as is implied by the screen size and zoom factor.

JFIF (JPEG File Interchange Format) -- A minimal file format which enables JPEG bitstreams to be exchanged between a wide variety of platforms and applications. It supports a number of JPEG sponsored compression algorithms, including both the typical DCT & Huffman scheme and the “Raw” format.

Jaggies -- The jagged stair-stepping effect often seen in images whose resolutions are so low that individual pixels are visible.

JPEG Compression -- A file compression standard established by the Joint Photographic Experts Group that uses a combination of DCT and Huffman encoding to compress images. JPEG is a "lossy" compression algorithm, meaning that it slightly degrades image quality.

Lossless compression -- Reduces the size of files by creating an internal shorthand that rebuilds the data as it originally were before the compression. Thus, it is said to be non-destructive to image data when used.

Lossy compression -- A method of reducing image file size by throwing away unneeded data, causing a slight degradation of image quality. JPEG is a lossy compression method.

LPI (Lines per Inch) -- The frequency of horizontal and vertical lines in a halftone screen.

LZW (**Lempel-Ziv-Welch**) -- is a lossless data compression algorithm. The algorithm is derived from the *LZ77* algorithm presented by Abraham Lempel and Jacob Ziv in a paper entitled "A Universal Algorithm for Sequential Data Compression" in the IEEE Transactions on Information Theory, May 1977. In 1978 they developed an improved version, now known as the *LZ78* algorithm, which was later improved by Terry Welch in 1984, resulting in the *LZW* algorithm.

Marquee -- The outline of dots created by the selection tool on an image when an operator is performing a task such as cropping, cutting, drawing a mask, etc.

Mask -- A defined area used to limit the effect of image-editing operations to certain regions of the image. In an electronic imaging system, masks are drawn manually (with a stylus or mouse) or created automatically--keyed to specific density levels or hue, saturation and luminance values in the image. It is similar to photographic lith masking in an enlarger.

Moire -- A visible pattern that occurs when one or more halftone screens are miss-registered in a color image.

Morphing -- A special effect used in motion pictures and video to produce a smooth transformation from one object or shape to another.

Motion Picture Experts Group (MPEG) Video Compression -- The MPEG specification is a specification for an encoded data stream which contains compressed audio and video information. MPEG was designed specifically to store sound and motion-video data on standard audio Compact Discs (CD) and Digital Audio Tapes (DAT). The main application for MPEG is the storage of audio and video data on CD-ROMs for use in multimedia systems, such as those found on the Apple Macintosh platform and in the Microsoft Windows environment. Such systems require the ability to store and play back high-quality audio and video material for commercial, educational, and recreational applications. The new MPEG-2 standard allows the transmission of MPEG data across television and cable network systems.

NTSC -- A 60 field video format used primarily in the United States, (abrv. for National Television Standards Committee)

PAL -- A 50 field video format used primarily in Europe, (abrv. for Phase Alternating Line)

Palette -- A thumbnail of all available colors to a computer or devices. The palette allows the user to choose which colors are available for the computer to display. The more colors the larger the data and the more processing time required to display your images. If the system uses 24-bit color, then over 16.7 million colors are included in the palette.

Photo CD -- The Photo CD combines the best of 35-mm film imaging and digital technology, so you can show your pictures on a television or computer monitor. Images can be transferred to a photo CD disc from new or existing developed 35-mm film, 35 mm slides, and other formats.

Photo YCC -- A color encoding scheme developed by Kodak for its Image PAC file format

PIC -- A standard file format for animation files.

PICT -- A graphics file format used primarily on Macintosh computers. PICT files can contain both object-oriented and bit-mapped graphics. There are two types: PICT I and PICT II. PICT II is the current standard and supports color up to 24-bit.

Pixel (PICture ELement) -- The smallest element of a digitized image. Also, one of the tiny points of light that make up a picture on a computer screen.

PNG -- (Portable Network Graphics) pronounced ping. A new standard that has been approved by the World Wide Web consortium to replace GIF because GIF uses a patented data compression algorithm. PNG is completely patent and license-free.

Portable Document Format (PDF) -- A document description language developed by Adobe Systems, Inc. to enable users to exchange and view electronic documents easily and reliably, independently of the environment in which they were created. PDF relies on the same imaging model as the PostScript® page description language to describe text and graphics in a device-independent and resolution-independent manner. To improve performance for interactive viewing, PDF defines a more structured format than that used by most PostScript language programs. PDF also includes objects, such as annotations and hypertext links, that are not part of the page itself but are useful for interactive viewing and document interchange.

PostScript -- A page description language developed by Adobe Systems, Inc. to control precisely how and where shapes and type will appear on a page. Software and hardware may be described as being PostScript compatible.

RAM -- Random Access Memory . The most common type of computer memory; where the CPU stores software, programs, and data currently being used. RAM is usually volatile memory, meaning that when the computer is turned off, crashes, or loses power, the contents of the memory are lost. A large amount of RAM usually offers faster manipulation or faster background processing.

Raster -- Raster images are made up of individual dots; each of which have a defined value that precisely identifies its specific color, size and place within the image. (Also known as bitmapped images.)

Real Time Image Processing -- A data processing system that responds immediately to the user. Image processing that executes each function immediately and displays it at a high enough resolution to be viewed.

Render -- The final step of an image transformation or three-dimensional scene through which a new image is refreshed on the screen.

Resize -- To alter the resolution or the horizontal or vertical size of an image.

RGB -- Short for Red, Green, and Blue; the primary colors used to simulate natural color on computer monitors and television sets.

RIP (Raster Image Processing) -- A piece of hardware or software that converts object-oriented graphics and fonts into the bit maps required for output on a printer.

ROM -- Read Only Memory. ROM can be read and not updated or changed by the computer. Usually ROM refers to specific electronics in a computer; however nonalterable disks like CDs or CD ROMs are another type of read only memory. Read Only Memory is non-volatile--it does not disappear when power is shut off.

Saturation -- The degree to which a color is undiluted by white light. If a color is 100 percent saturated, it contains no white light. If a color has no saturation, it is a shade of gray.

Scanner -- An optical device that converts images - such as photographs - into digital form so they can be stored and manipulated on computers. Different methods of illumination transmit light through red, green and blue filters and digitize the image into a stream of pixels.

SCSI(Small Computer System Interface) -- A computer connection that is preferred for digital imaging because of its high speed and standard interface.

Serial -- A data transfer method used to connect a peripheral, such as a digital camera, to a computer. The serial connection will allow the peripheral to transfer data to the computer and vise versa.

Smoothing -- Averaging pixels with their neighbors. It reduces contrast and simulates an out-of focus image.

Square Pixels - Rectangular Pixels -- Digital cameras utilize camcorder technology, which have rectangular pixels because TV displays are rectangular. For computers square is better because computer monitors display square pixels. When you start with a rectangular pixel you have to "lob" off part of the pixel to display it. Essentially you lose image data and introduce artifacts with rectangular pixels.

Tagged Image File Format (TIFF) -- TIFF describes image data that typically comes from scanners, frame grabbers, and paint- and photo-retouching programs. TIFF is not a printer language or page description language. The purpose of TIFF is to describe and store raster image data. A primary goal of TIFF is to provide a rich environment within which applications can exchange image data. This richness is required to take advantage of the varying capabilities of scanners and other imaging devices. Though TIFF is a rich format, it can easily be used for simple scanners and applications as well because the number of required fields is small.

Originally developed by Aldus Corporation, it is now managed by Adobe Systems, Inc.

Unsharp Masking -- A process by which the apparent detail of an image is increased; generally accomplished by the input scanner or through computer manipulation.

VGA -- Video Graphics Array- a resolution type that uses analog signals and is only capable of 16 colors @ 640x480 and 256 colors @320x200 respectively. VGA is considered to be the lowest common denominator in graphics display

Watermarks -- A feature of scanners that can automatically add date, time, or specific text to your images. The DC 260 offers the ability to add graphic or logo watermarks to images.

WORM (Write Once; Read Many) -- Most common to optical disks, WORM refers to data storage that cannot be changed once written. However, it may be read as many times as desired.

WYSIWYG -- What You See Is What You Get. Refers to the ability to output data from the computer exactly as it appears on the screen.

XGA -- Extended Graphics Array supports resolutions up to 1024 x 768 @256 colors.

XML -- (eXtensible Mark-up Language) XML is a standard to create electronic documents on the Internet. The first application of XML is to create Web pages, similar to existing ones but more dynamic. XML is not limited to only Web pages; potential documents include forms, EDI messages, channel definition (for push technology), application descriptions, etc.

XML Parser -- A parser is a library that reads and interprets XML documents for applications.

Z-Buffer -- A method used by high end computers to depict depth of objects on a computer screen. The Z-buffer is implemented within the hardware rendering engine of a computer, typically used on 3D modeling computers.

Zip Compression -- A type of file compression that decreases the total size of a file and allow larger amounts of data to be transferred in fewer bytes. A zip file typically ends with a .zip extension.