Microforms as Library Tools

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MICROGRAPHICS DATES TO 1839; however, it was not until the late 1930s when libraries began making microfilm copies of rare documents for public use and also began converting newspaper files to microfilm as a means of conserving storage space and preserving newsprint, which generally has a rapid decomposition rate in its original form. By the 1950s, there was a widespread realization that microfilm could be used not only for the preservation of back files and oversized documents, but as an integral part of *active* information systems (as opposed to archival storage). Microform technology came into its own in the 1960s. During that decade, the micrographic industry became a $500 million/year endeavor, largely as a result of improvements in equipment and materials. Less expensive readers and reader-printers were made available, enabling libraries and business firms to make active use of microforms. Advances in optics and equipment design made microform readers easier to operate and use. Also in the 1960s, micrographic technology and data processing were combined to permit the output of computers to be recorded directly on microforms rather than on paper. This is called computer-output microfilming (COM). In the educational field, significant increases were made in the availability of microforms through expansion of commercially produced micropublications and through efforts of the U.S. Office of Education.

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By the early 1970s, portable microform readers, referred to as "lap readers," began to appear on the market, enabling people to utilize microforms in the classroom, at home, and in other places, as well as in the library. Standardization of microforms made significant headway early in the decade. By 1972, micropublishing was receiving unprecedented emphasis with more than $50 million of microforms being produced annually. Microform hardware and services accounted for millions of additional dollars.

In the early 1980s, micrographics is today being combined with many other technologies—data processing, word processing, facsimile transmission, electronic mail, information retrieval systems, etc. Micrographics has become a subsystem of a total information transfer system. We see this trend continuing and micrographics being a part of the so-called "office of the future."

What is Micropublishing?

Micropublishing is a communications technique which uses photographic processes to miniaturize printed or graphic material. It involves four phases:

1. *Photographing* the material,
2. *Duplicating* or reproducing the microcopies for distribution,
3. *Retrieving* stored microimages by means of manual or automatic devices, and
4. *Displaying* images on a reader screen for viewing and using a reader-printer for producing hard copies.

Micropublications can be issued in black-and-white and in full color. They come in several forms and sizes: roll film, in 16mm or 35mm width; and microfiche (a sheet of microfilm containing multiple microimages in a grid pattern—usually 105 x 148mm with 98 images). Publications in microform are divided in three basic categories:

1. *Micropublishing*—to issue new (not previously published) or reformatted information in multiple-copy microform for sale or distribution to the public. The following are some examples of true micropublishing. Verbatim transcripts of CBS News television broadcasts are available only on microfiche. *CORE (Collected Original Resources in Education),* a journal for the educational researcher, is published only on microfiche. Articles are collected from many newspapers on a specific subject (e.g., abortion, solar energy, child abuse) and are organized and indexed. This is material

previously published in hard copy that is reformatted and published on microfiche.

2. *Micro-republishing*—to reissue material previously or simultaneously published in hard copy in multiple-copy microform for sale or distribution to the public. Two common examples of micro-republishing include: (1) newspapers, hundreds of which are filmed on 35mm roll microfilm and sold to libraries all over the world; and (2) many popular magazines such as *Flying, Boating, Stereo Review, Popular Electronics,* etc., which are published in hard copy and in microform simultaneously.
3. *Microprinting*—to make single or multiple copies of proprietary information in microform. The Western Electric Company microfilms engineering drawings and disseminates microforms of these drawings to hundreds of telephone company engineering offices. This information is *not* available to the public. Most insurance companies microfilm policy material that is *not* available to the public.

What are the benefits of micropublishing? These include:

1. *Reduced printing costs*—Microforms can be produced for about one-tenth the cost of printing on paper.
2. *Quicker dissemination*—Turnaround time to prepare and disseminate information on microforms instead of paper can put the material in the hands of the user in one-fourth the time.
3. *Easier retrieval*—Microforms provide fingertip accessibility. All one does is select the desired microform and insert it in a reader.
4. *Lower cost distribution*—Six microforms can be sent by first-class mail coast to coast for only eighteen cents; the equivalent amount of information on paper mailed the same way would cost over eight dollars.
5. *Space savings*—Microforms give compactness. Over 10,000 pages can be stored on microform in an area 105mm x 148mm x 25.4mm (4″ x 6″ x 1″).
6. *Ease of handling*—No longer is it necessary to juggle cumbersome catalogs and manuals, or fumble through stapled, dog-eared pages, often misfiled.
7. *File uniformity*—Each microform is produced to a standard format which eliminates the handling of documents, books and periodicals of many shapes and sizes.
8. *Increased durability*—Microforms can withstand much more rugged handling than paper.

9. *Rapid updating*—Microforms reduce updating delays. Instead of having dozens of pages to file when updated material is received, only one or two microfiche need be slipped in the file.

Microforms

The term *microform* is generic for any form, either film or paper, which contains microimages. The following is a description of the various microforms and an indication of the advantages and disadvantages of each.

Roll Film

Roll film is a length of processed microfilm on a reel or in a cartridge or cassette. Roll microfilm is most commonly 16mm or 35mm wide. The traditional standard length of roll film is 100 feet and has a thickness of 5 mils. However, lengths of up to 140 feet are becoming more common as new, thinner-base films are used. The longer lengths are housed on the same size reel or cartridge.

Roll microfilm is nonperforated—that is, it does not have sprocket holes. There are three very common formats for arranging the images on roll microfilm: (1) the simplex-comic orientation, where a single line of images are lined up side by side, like a comic strip; (2) the simplex-cine orientation, where a single line of images is continuous, quite like motion-picture film; and (3) the duplex mode, where the front and back of a document appear side by side, forming two channels of images down the length of the film.

Reels are flanged plastic holders for processed roll microfilm. Cartridges and cassettes are plastic enclosures that protect the film and simplify inserting the film into readers, reader-printers and retrieval devices. Cartridges have a single core and cassettes have two cores.

Roll microfilm is the least expensive to produce, provides excellent packing density, and, depending on the indexing, retrieval can be quite fast for locating information. It is easy to produce hard copy from roll microfilm, and roll film provides outstanding file integrity. The shortcomings of roll film are the inability to update the information easily, and it cannot be duplicated by the user.

Aperture Cards

An aperture card is a card with a rectangular hole or holdes specifically prepared for the mounting or insertion of a chip or strip of microfilm. The most common size of aperture card is EAM (electric accounting machine) tab card size, 3 1/4" x 7 3/8". The typical aperture accommodates a 35mm x 2" chip of film containing one frame (one image). There are many other sizes of aperture cards and aperture arrangements available. The film may be held in place by either pressure-sensitive tape or by insertion into a transparent sleeve.

Copy cards are aperture cards containing unexposed chips of raw film for contact duplication purposes. Image cards are cards containing a processed image.

The cost of aperture cards is reasonable, packing density is good, and the ease of updating and retrieval is excellent. The aperture card can be duplicated and hard copy produced very easily. File integrity can, however, be a problem.

Microfiche

Often referred to as simply "fiche," microfiche is a sheet of microfilm containing multiple images in a grid pattern. Microfiche is produced in a number of sizes and formats. The most common and standard size is the international "A6," 105 x 148mm (approximately 4 by 6 inches). For microfilming source documents, the most common format is 7 rows by 14 columns, providing 98 frames, which is usually produced at a 24X reduction. For computer-output microfilm, the standard format is 15 rows and 18 columns providing 270 frames of the equivalent 11 by 14 inch document at a reduction of 48X. Microfiche with very large quantities of images at high reductions (e.g., 3200 pages reduction) are called "ultrafiche." Regardless of size or format, microfiche contains an eye-readable heading that identifies the contents. The heading area may be color-coded to aid retrieval.

The cost of microfiche is good; packing density and ease of updating is very good. Retrieval of fiche is excellent, as is the ability to duplicate and make hard copy. The capability of reproducing hundreds of images quickly, simultaneously and at low cost by duplicating a single fiche is very important. File integrity can be a problem. There are new, "updatable" microfiche systems in which images can be subsequently added to a master fiche.

Jackets

A jacket is simply a transparent plastic carrier with single or multiple sleeves or pockets made to hold strips of microfilm cut from rolls. Jackets may contain 16mm film, 35mm film, or both. Jackets are usually either tab size or 4 by 6 inches (105 by 148mm). Jackets, like fiche, have eye-readable headings which may be color-coded and/or notched to aid retrieval. Duplicates of jackets look like microfiche.

The cost of producing jackets is fair, the packing density is good, and retrieval is excellent. Jackets can be updated by removing and/or adding selected strips of film. Hard copy and duplicates are produced the same way as from fiche. There is much manual labor involved in producing and updating jackets.

Micro-opaques
Similar to microfiche in configuration, micro-opaques are, as their name implies, images on opaque stock. Therefore, images may be stored on both sides. Unlike microfiche, where transmitted light is used for blowback, opaques use reflected light. Today, micro-opaques are only used by one micropublisher, and equipment availability is quite limited.

The Film in Microfilm

Obviously, one of the most important components of a micrographic system is the film itself, although only a supply item. Film is used for two functions in the system: (1) for recording by a camera, COM or updatable system; and (2) as the duplicating medium for distribution copies. Microfilm may be duplicated through several generations, and both the camera film and the duplicates may have either positive- or negative-appearing images in any generation. The polarity of microfilm is determined by its appearance and not by what it is made from. Most business documents and library material are made up of dark text on a light background, exactly like this page. This is a positive-appearing image. A negative-appearing image is just the opposite—light text on a dark background.

There are seven different types of microfilm which fall into three categories, as follows:

Camera films
1. Silver-gelatin
2. Dry silver
3. Transparent photoconductor (TPC)

Duplicating-Reversing
4. Silver-gelatin
5. Vesicular

Duplicating-Nonreversing
6. Silver-gelatin direct duplicating
7. Diazo

Silver-gelatin camera film may have a positive or a negative image, depending on how it is processed. Dry silver film produces a negative image. Transparent photoconductor films produce positive images. The reversing duplicating films produce a positive image from a negative or a negative from a positive. Nonreversing duplicating films produce negatives from negatives and positives from positives.

Silver-gelatin film is film that is coated with a silver-halide emulsion. Silver-halide is a compound of silver and one of the following elements, known as halogens: chlorine, bromine or iodine. Silver-gelatin film is both a camera film and a duplicating film.

Dry silver film is a nongelatin silver camera film that is exposed by light and is developed by application of heat.

Transparent photoconductor film is a camera film that includes a photoconductive layer which, in combination with a special electrostatic image system, permits the adding of new images or overprinting existing images onto an existing photoconductor film.

Vesicular film is a duplicating film in which the light-sensitive component is suspended in a plastic layer. On exposure to ultraviolet energy, the component creates optical vesicles (bubbles) in the layer. These imperfections form the latent image. The latent image becomes visible and permanent by heating the plastic layer and then allowing it to cool. Duplicating with vesicular film may be done in an ordinary room.

Silver-gelatin direct duplicating film has the same makeup and properties as those described for silver-gelatin film.

Diazo film is a duplicating film, sensitized by means of diazonium salts, which, after exposure to ultraviolet light (strong in the blue to ultraviolet spectrum) and after development by ammonia, forms an image. Duplicating with diazo film may be done in an ordinary room.

Sensitized Layer and Base

Microfilm can be broken down into two components: (1) the support, usually referred to as the base; and (2) the sensitized layer, which on silver films is called the emulsion. Microfilm relies exclusively on acetate and polyester bases; both are classified as safety films—that is, they will not support combustion.

Acetate film is a cellulose derivative with its main advantages being good clarity and a low propensity for static generation. (Static discharge inside a camera can fog film.)

Polyester base is a petroleum derivative that is rapidly growing in popularity. A high propensity to static generation has limited this base to the duplicate film market, but recent developments in static control have allowed polyester to make inroads as a camera film. Polyester film has demonstrated superior performance in the following areas:

It maintains dimensional stability.
It resists heat, humidity and most chemicals.
Polyester film does not tear, break or curl.
It does not yellow or become brittle with age.
Because of its strength, polyester permits the use of thin bases which allow high information-packing densities.

Size and Thickness

Standard microfilm widths are 16mm, 35mm and 105mm. Roll microfilm is available in lengths of 100 feet (30m) and multiples thereof. Microfiche (cut sheets of film) is available in 105mm x 148mm. Microfilm and microfiche are produced in thicknesses of 2.5, 4.0, 5.0, and 7.0 mils (with metric equivalents of 0.06mm, 0.10mm, 0.12mm, and 0.17mm, respectively).

Archival Quality and Permanence of Microfilm

Archival quality film is of fundamental importance to the micrographic field. However, archival quality is little understood and frequently the subject of heated debate, arising from the need to know how long a film will last. The basic definitions and criteria for evaluation have been established by the American National Standards Institute (ANSI).

ANSI defines archival record film as "a photographic film composed and treated so that under archival storage conditions...it is suitable for the preservation of records having permanent value."[1] Three important points emerge from this definition:

1. the film by itself is not archival; it can, however, become "suitable" for the preservation of records of permanent value, *if*
2. the film is stored under archival conditions, and *if*
3. the film has been properly manufactured, processed and handled.

The interdependence of these factors is highlighted in the foreword to the ANSI PH1.41 standard:

> Everyone concerned with the preservation of records on photographic film should realize that specifying the chemical and physical characteristics of the material does not, by itself, assure archival behavior. It is essential to provide proper storage temperature and humidity, and protection from the hazards of fire, water, fungus, and certain atmo-

> spheric pollutants. Archival record films must be stored under the conditions specified in pertinent American National Standards (...PH1.43-1979).[2]

From the above, it is apparent that, even when film qualifies as archival record film, no guarantee is given of the time period for which the film will last, only that it is *suitable* for storing permanent records. Moreover, the very nature of the standards is such that test procedures must be defined in order to establish the criteria by which a film can be judged to have been properly manufactured and processed. Such tests have traditionally taken the form of chemical and/or accelerated aging tests, and ANSI has been instrumental in designing test procedures and establishing criteria. To date, only criteria for silver film have been established.

In order for silver film to be classified as archival, the amount of thiosulfate ion (fixer) remaining on the film after processing must be measured, using either the methylene blue or the silver densitometric test methods specified by ANSI PH4.8.[3] If the amount is less than 0.7 micrograms per square centimeter, the film can be certified as archival. Consequently, archival quality is not a property that can be imparted to a film either at the time of manufacture or at the time of processing. Rather, it is a combination of factors, all of which require proper manufacturing, processing, storage and handling. If these steps are accomplished properly and the film is stored for archival purposes, this is the best guarantee that the film will last for the longest possible period.

In designing a micrographic system, it is important to consider whether it is necessary for the microfilm to be archival record film. In a majority of cases, archival quality will not be a systems requirement, and the matter is purely of academic interest. If however, archival quality of film is a prerequisite, then the subject merits considerable study oriented toward the requirements of the system.

Before getting into the technical aspects regarding the keeping characteristics of microfilm, consideration should be given to the following three important points:

1. The span of time the information on the microfilm will be required;
2. Whether the microfilm will be used frequently for research or can be stored for posterity with very little use; and
3. Whether replacements for the microfilm are readily available.

It is now widely accepted that the terms *archival* and *permanent* (forever) are synonymous. It costs money and requires special effort to produce and maintain archival microfilm; therefore, before specifying that your microfilm must be archival, consider your requirements. For example, computer output of everyday business records which are updated weekly or monthly usually doesn't need archival microfilm, since the material is replaced often. However, microfilm of the items in a rare book collection are likely required to be kept permanently. Therefore, every effort should be made to have archival quality film for this purpose. If you buy microfilm from a reputable commercial or government micropublisher, the microfilm is almost always replaceable, so there is no real need to worry about archival permanence.

When archival silver-gelatin microfilm is required, keep in mind that to be truly archival, it must be stored under controlled conditions and very rarely used. The everyday working copy should be an expendable duplicate, which is normally made on a nonsilver film, such as diazo or vesicular. It is possible to use silver-gelatin duplicates; however, it also should be noted that the emulsion tends to scratch more easily than the nonsilver film.

"Archival permanence" means the ability of the *entire processed microfilm* to retain its original characteristics and to resist deterioration over time. The entire processed microfilm refers to the base material, the emulsion, and the processing used. The method of handling and storing the film also affects its life. It must be emphasized that the concept of "archival" involves much more than just the chemistry of processed microfilm. Additional characteristics of concern include: folding endurance, viscosity, ignition, burning rate, curl, and brittleness. In the past, when one used the word *archival*, the question of time was always raised. Now, the Archivist of the United States says the term *archival* means forever.[4] In practice, however, "archival permanent microform has come to refer to film which will last as long as 100 percent rag-stock paper. Rag-stock paper is claimed to have a life of hundreds of years. Recent changes in the standards have established three classifications, as follows:

Medium-Term-These are microforms which will have a useful life of ten years. Change in the photgraphic image is acceptable provided that it is still usable by the consumer.

Long-term-These microforms must have a useful life of 100 years. Again, the criteria of usability is important, since some image change is acceptable.

Archival-These microforms are intended for indefinite keeping and for the preservation of records having permanent value. Usability is not the only criteria for microforms having this classification, since they also must have permanent image-keeping properties.

Safety Film

All microfilm, both processed and unprocessed, should meet minimum requirements with respect to hazards from fire. In order to be classified as Safety Photographic Film, a photographic film must: (1) be difficult to ignite, (2) be slow-burning, and (3) produce a limited amount of toxic oxides of nitrogen during the decomposition. The detailed requirements for Safety Photographic Film are covered in American National Standard PH1.25.[5] These requirements apply equally to polyester- and cellulose-based films. A film that meets this standard may have the word "safety" or the symbol "S" included in the edge printing, but this is not mandatory.

Processed Microfilm

Processed microfilm on cellulose-based materials should meet the requirements of American National Standard PH1.28.[6] The equivalent for polyester-based film is ANSI PH1.41.[7] These standards specify those criteria (ignition rate, viscosity, etc.) that make the film capable of meeting archival requirements.

The procedures, chemicals, temperatures, and wash practices used in processing microfilm are critical in obtaining "archival" microfilm. The effect of residual chemicals on film can seriously affect the life of the image. For archival life, the residual thiosulfate (sometimes called "hypo" or fixer) should not exceed 0.7 micrograms per square centimeter. Although not a requirement for medium- and long-term storage, it is a good practice to wash the film to these limits. If the microfilm is to be used and discarded within a very short time, it can be considered expendable and the above requirement disregarded.

Until recently, the most commonly used test for residual thiosulfate has been the mercury bromide (Ross-Crabtree) method. This method is now obsolete, and has been replaced by the methylene blue and the silver densitometric methods. Both of these methods are specified in American National Standard PH4.8. The methylene blue method is extremely reliable and gives repeatable results at the low level of thiosulfate required for archival processing of microfilm. The silver densitometric method is not as precise as the methylene blue method at the low level of thiosulfate required for archival processing of microfilm; however, the silver densitometric test is good for an everyday quick check.

Storage of Microfilm

American National Standard PH1.43[8] covers the recommended storage conditions for medium, long and archival storage. Consult the standard for complete requirements. Table 1 gives some general storage recommendations.

TABLE 1
MICROFILM STORAGE RECOMMENDATIONS

	Medium-term	*Long-term & Archival*
Relative Humidity		
Cellulose base	Maximum of 60 percent	15-40 percent
Polyester base	30-60 percent	30-40 percent
Temperature	Maximum of 25°C (77°F), preferably below 20°C (68°F). Peaks for short periods shall not exceed 32°C (90°F).	Maximum of 21°C (70°F). Additional protection may be obtained at lower temperatures.

Technical Characteristics

There are many technical items regarding film, such as resolution, acutance, density, gamma, and contrast. Which space limitations prohibit from being covered in this article. Let me just say that reputable manufacturers produce good-quality film. Where special applications require knowledge of these topics, consult the references cited here and the manufacturers.

Conclusion

Microforms are a very viable way to preserve information. Archival permanence can be provided when needed; however, the permanence of the image depends not only on using the film that is capable of meeting archival requirements, but also on the manner in which it is processed and stored.

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2. Ibid., p. 4.

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