RLG Guidelines for Microfilming to Support Digitization

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Foreword

RLG has focused on the preservation of deteriorating collections in research libraries, archives, and other repositories for more than 25 years. A multitude of activities have taken place under the umbrella of RLG's preservation program. Addressing preservation problems collaboratively has allowed RLG members to achieve collectively what no single institution could achieve on its own. This collaboration has often led the way to establishment of best practices for preservation and has made important contributions to preservation microfilming.

RLG's cooperative preservation microfilming activities and projects began in 1983. Over the next 14 years, 32 RLG member institutions participated in a series of eight cooperative filming projects, preserving more than 146,300 volumes and 1,200 linear feet of archival collections. The projects, largely funded by the National Endowment for the Humanities (NEH), also provided crucial experience for many preservation practitioners and laid the groundwork for the development of best practice guidelines that would help libraries and archives preserve their collections through the production of microfilm that is complete and long-lived.

When the *RLG Preservation Microfilming Handbook* was published in 1992 it represented a major revision and expansion of the earlier guidelines that had been developed to adapt commercial filming practices to the particular needs of libraries. Drawing on experts from RLG member institutions, libraries, commercial micropublishers, not-for-profit filming agencies, a regional network, and the National Institute for Standards and Technology, the 1992 handbook exemplified the state-of-the-art guidelines governing the production of preservation microfilm for monographs and serials.

In 1994 a second set of guidelines—the *RLG Archives Microfilming Manual*—was published to address the unique needs of microfilming archival materials. Developed as part of the RLG Archives Preservation Microfilming Project (APMP), the *RLG Archives Microfilming Manual* was the first set of consensus-based guidelines to codify best practices for microfilming library and archival material that is not serial or uniform. It was also the first set of RLG microfilming guidelines to address a "hybrid approach" to preservation and access: the digitization of preservation microfilm. In Chapter 8 of the *RLG Archives Microfilming Manual*, "Planning for the Future: Film Digitization," Anne R. Kenney discussed preservation microfilm production and how film characteristics affect a film's digitization. Understanding that microfilm meeting very high technical quality standards would allow for cost-effective scanning and yield high-quality digital images, Kenny suggested that existing preservation microfilm guidelines would need to be made more technically rigorous in some areas in order to create microfilm more amenable to automated digitization processes. Testing this assertion, however, was not part of the NEH grant that funded the RLG APMP.

After the publication of the *RLG Archives Microfilming Manual*, requests were made to update the RLG microfilming guidelines to cover the proposed hybrid approach. However, no large-scale, cooperative microfilming projects were underway to serve as the basis for the development of guidelines that would be accepted and endorsed by the preservation community. In the past few years, however, the culmination of institutional projects, expert advice, and cooperative learning has identified a combination of factors that contribute to the creation of preservation microfilm that can be effectively and efficiently scanned to produce high-quality digital images.

Lars Meyer (Emory University) and Janet Gertz (Columbia University) wrote these new guidelines in consultation with colleagues, service vendors, and product vendors. They represent the state-of-the-art thinking on improvements to film preparation processes and certain technical microfilming specifications for high-quality microfilm that is cost-effective to scan.

These guidelines do not take the place of the *RLG Preservation Microfilming Handbook* or the *RLG Archives Microfilming Manual*. Instead, they should be used together with the earlier publications and only when the microfilm being produced is highly likely to be digitized.

Today, the persistent, loud cry for digitization often drowns out the equally important voice for preservation. However, for brittle books one can have both. These new guidelines should help libraries and archives around the world achieve the viable option of using microfilm for preservation and digitization of the film for enhanced access.

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RLG Guidelines for Microfilming to Support Digitization

by Lars Meyer and Janet Gertz

Introduction

These guidelines address the creation of microfilm that can be digitized more effectively and efficiently to produce high-quality digital images. They are meant to complement the existing RLG microfilming guidelines—*RLG Preservation Microfilming Handbook and the RLG Archives Microfilming Manual*—as well as the microfilming standards issued by the Association for Information and Image Management (AIIM), the American National Standards Institute (ANSI), the International Organization for Standardization (ISO), and other national and international standards organizations.

These recommendations aim, first, to help institutions optimize digital image quality by improving the microfilm that may be digitized and, second, to reduce some of the need for human intervention in the scanning process, thus, in theory, lowering the cost of digitizing film. In some cases additional work is recommended during the filming process in order to reduce work during the scanning process.

Some materials and film will lend themselves more readily to automatic end-to-end scanning of a reel of film and simultaneous creation of structural metadata. Other materials, such as those with foldouts, continuous-tone images, and skewed pages, for example, will require more human intervention in the film digitization process. In short, the more uniform the materials being filmed, the more uniform the microfilm will be, and the more effective and economic the microfilm scanning will be.[1]

Selective Application of These Guidelines

Depending on an institution's certainty about whether and when its microfilm will be digitized, it may choose to follow only a subset of these guidelines. All institutions are strongly encouraged to follow the sections that pertain to image creation and film quality (reel programming, targeting, filming of oversize materials, etc.). By following these guidelines the institution will create film that is uniform and thus easier to scan because it requires fewer manual scanner adjustments to account for changes in reduction ratio and other nonuniform features.

It may, however, be inefficient for an institution to record detailed collation information or employ blipping or other data recording methods if it is not clear that a film scanning service will actually be able to capitalize on data recorded in a particular

[1] For discussion of the costs of film-first, scan-second digitization, see Stephen Chapman, Paul Conway, and Anne R. Kenney, *Digital Imaging and Preservation Microfilm: The Future of the Hybrid Approach for the Preservation of Brittle Books* (Washington, DC: Council on Library and Information Resources, [1999]) and Paul Conway, *Conversion of Microfilm to Digital Imagery: A Demonstration Project. Performance Report on the Production Conversion Phase of Project Open Book* (New Haven, CT: Yale University Library, 1996).

format. This may well be the situation if scanning is not planned in the near future. On the other hand, such data has real potential to facilitate the digitization effort. It may be possible to manipulate data captured during the scanning process to generate metadata useful in postscan processing of the digital images. Likewise, if collation information (see below) is saved in a machine-readable form, it may also be useful in generating structural metadata that can assist or complement the microfilm digitization and image presentation processes.

In determining which sections of the guidelines to follow, institutions should consult with their filming and scanning services about which changes in microfilming practice will lead to actual savings during film scanning. To arrive at a viable estimate, institutions need to consider the entire chain of preparation, filming, scanning, and presentation of the digital images, focusing on the interactions of communications, workflows, and technologies related to each step.

Assumptions

The existing RLG microfilming guidelines are still valid and should be followed in creating preservation-quality microfilm. When the goal is to create preservation microfilm and scan the resulting film, the new, stricter guidelines apply.

These guidelines differ from *RLG Preservation Microfilming Handbook* and the *RLG Archives Microfilming Manual* in these areas: film preparation; technical microfilming procedures and specifications; and quality-control inspection.

These guidelines assume that:

- The source materials that will be filmed and subsequently digitized from the film are monographs or serials composed primarily of text and relatively few halftone, continuous-tone, or color illustrations. With some modification these guidelines can accommodate archival and manuscript materials that readily lend themselves to high-contrast microfilming and bitonal film scanning. Materials that require primarily grayscale or color scanning will need to be addressed by future guidelines.

- The images created from scanning the film will meet the *Benchmark for digital reproductions of monographs and serials as endorsed by the DLF* (www.diglib.org/standards/bmarkfin.htm). For black-and-white text and line drawings, the images should be 600 dpi (relative to the original materials), 1-bit or bitonal, and the dimensions of the original document should be recorded in the metadata to facilitate scaling paper reproductions to the same size as the original. The file format of the master image should be TIFF.

- Microfilm cameras differ in capability. Newer cameras can more readily achieve some of these recommendations than older models. To determine whether and how far to follow these recommendations, an institution should discuss the details of actual camera capability with its filming service (in-house or contract).

- Film scanners differ in capability. The linear pixel array of most film scanners on the market today ranges from 8,000 to 10,000. Some scanners can only scan bitonally while others can scan in grayscale. As film scanning technology evolves, these guidelines will need to change to address materials that require grayscale or color

scanning. Institutions that intend to scan shortly after filming should discuss the specific capabilities of the scanning equipment with their scanning services.

- Current microfilm scanners obtain better results from negative film than from positive film, although positive film can be scanned successfully if no negative is available. It is better to scan second-generation negative film (2N), both in order to avoid excessive handling or possibly scratching the camera negative and because film manufactured explicitly for the making of intermediate negative film, or "print masters," has greater tonal range than camera negative film. Experience has shown that 2N film made in accordance with microfilm quality standards and guidelines provides a basis for satisfactory digital images.

Film Preparation

Reel Programming

Current guidelines allow much leeway in reel programming. Often, volumes of different sizes are grouped together on the same reel and each volume is filmed at the optimal reduction ratio for that volume. Some camera systems have excellent automatic exposure controls that can minimize density variation across a reel if the qualities (contrast, reflectivity, etc.) of the source documents are highly variable. This allows for reel programming with frequent changes in exposure settings that can be accomplished relatively easily during filming. However, microfilm scanning is optimized if the documents on a reel are uniform in size, filmed at a single reduction ratio, and filmed with minimal variation in density across the reel. Therefore, regardless of whether an institution knows in advance that it will scan its film, these guidelines recommend planning during reel programming to produce film that is better suited to digitization.

The following modifications to reel programming workflow are recommended where possible and appropriate. Filming serial volumes out of sequence in order to achieve a more uniform reel is *not* recommended.

- Program volumes of reasonably equal height together on a given reel, so that the camera operator does not need to change the reduction ratio from one volume to the next. Managers should explicitly request that all volumes on a given reel be filmed at the same reduction ratio. A uniform reduction ratio across all volumes on a reel should provide for both more efficient filming and better automated film scanning.

- Program materials at the lowest possible reduction ratio at which the camera system will still produce a sharp image.[2] This maximizes the amount of detail captured by the film that can, in turn, be captured by the film scanner.

- If it is not possible to program by size or if the reduction ratio must change within the reel, group materials requiring a higher reduction ratio at the *beginning* of the reel, followed by volumes that can be filmed at progressively lower reduction ratios. For example, when filming in the cine position, move from taller to shorter items.

[2] On some older cameras, low reduction—below 8x for example—does necessarily produce sharper images than medium reduction—at 10x, for example.

This allows the scanning technician to change or program scanner settings more systematically. But serial volumes of different sizes for a given title should *always* be filmed in chronological sequence.

- Group documents together by overall paper and ink contrast; degree of paper reflectivity, opacity and color; and ink opacity and color. This makes microfilming more efficient because the camera operator will adjust exposure settings less frequently, and it minimizes density variation across the reel (see Film Density, below).

  Institutions should first find out from their filming services whether they use automatic exposure systems and, if so, whether grouping materials this way for reel programming will be beneficial.

- Group volumes by their structural simplicity or complexity. Microfilming and film scanning are optimized if the microfilm technician and scanning technician do not have to deviate from adjusted settings or workflows to cope with foldouts, pocketed materials, images, or illustrations that require intentional second exposures and subsequent grayscale scans, etc. Whenever possible, program volumes with these features together on a given reel. Program volumes without special features together.

  Grouping volumes by their structural simplicity and complexity results in two general kinds of reels. Those reels that contain volumes free of special features will better lend themselves to automated, end-to-end scanning. In contrast, those reels that contain volumes with special features requiring more human intervention during the filming and scanning processes will be less efficient to film and scan. In a large-scale film scanning effort, knowing in advance how many reels—and which—require special handling should assist in predicting digitization costs.

Collation

Guidelines for collation have so far called for verifying that all components of a volume are present, that they are in the order that the publisher intended, and that all text and images are legible. "Thumb-through" collation rather than page-by-page collation has often been employed with materials that appear to be intact. It should, however, not be used when the resulting reel will be scanned. All missing or illegible components should be identified prior to filming. Refilming and inserting replacement pages identified during film inspection results in splices that may interfere with automated film scanning.

If an institution has decided to digitize its film soon after the completion of microfilming, it should check with its scanning service to determine which features in particular to record to assist in the digitization and image presentation processes. Among the features whose location, legibility, and completeness in a volume might be recorded are plates; pages that consist of or include halftone, continuous-tone, or color illustrations; torn pages; missing pages; inserts; blank pages; foldouts; bleed-through; show-through; foxing; mottling; overleafing; underlining and marginalia; tape-repairs; photocopied interlibrary loan replacement pages; printing dropouts; printing errors; pagination errors; and places where the original order of the pages is uncertain.

Phenomena that will introduce image skew during filming should also be identified and if possible eliminated at the collation stage. Problems in the sewing structure

that prevent some pages from opening uniformly within a given signature, as well as library security strips ("tattle-tapes"), can contribute to excessive image skew (see Skew, below).

If Optical Character Recognition (OCR) will be used on the digitized text, the collation stage should involve removing underlining or marginalia, if possible and allowable. (Alternatively, the underlining could be removed during postscan image enhancement, but this would require recording the location of such underlining or marginalia during film preparation or careful checking of each digital image, as well as considerable manual intervention with the images.)

The features recorded during collation should be verified when the film is inspected. Therefore, the collation sheet should be given to the film inspection technician for verification and amendment. The verified collation and inspection data can then be given to the scanning technician to flag frames that require scanner settings different from the majority of the frames being scanned. Alternatively, if an institution is not sure when the film will be scanned, the collation information could be filmed following the bibliographic target to assure that it is not lost over time. On the average, this will add two to three frames per volume.

Technical Microfilming Procedures

Targets

Target Placement

Film all start sequence targets (eye-legible, technical, etc.) as usual (see Tables 1 and 2, Target Application Charts). Do not use in-frame targets except for rulers for foldouts (see Foldouts, below), and do not intersperse targets within the sequence of text pages. Instead, film any explanatory targets—for example, describing intentional second exposure and changes in reduction ratio for oversize foldouts—as part of the initial target sequence.

A ruler is necessary to verify the reduction ratio as well as the effective resolution of the scanned images. If no target contains one, film a ruler that includes both inches and centimeters. Film the ruler immediately following all other technical targets at the same reduction ratio as the source materials that are being filmed.

Scanner Targets

The line pairs on traditional microfilm camera test targets, such as QA-2, QA-3, or the Microcopy Test Target (designated as ANSI/ISO 3334 and ANSI/AIIM MS 51), are designed to evaluate the performance of cameras, lenses, film, and film processors and duplicators. They cannot be used to evaluate the quality of digital images. Instead, scanning services should use *additional* targets designed specifically to evaluate the performance of film scanners. Consumers of film scanning services should specify the use of such targets.

Immediately following the microform technical target, film a scanner resolution target that can facilitate subjective evaluation of the performance of 1-bit microfilm

scanning. Note that when using high-contrast targets, for instance the RIT Alphanumeric Test Object, the capability to resolve small characters on the target does not necessarily correlate to similar resolution of comparable characters on the filmed pages, particularly if the source materials consist of non-Roman scripts or if the printing quality of the source materials is poor.[3] The RIT target "facilitates subjective quality control of a system's resolution; in other words, a person makes a visual assessment of a scanned target to identify the finest point at which he or she interprets the system to have resolved the block characters in all four quadrants."[4] It is especially useful in evaluating whether the digitization system is performing consistently, and in comparing systems.

If the RIT target is unavailable, consider using one of these alternatives:

- AIIM Scanner Test Chart #2, which includes type examples ranging in size from 4 to 10 points.
- The IEEE Facsimile Test Chart, which contains samples of printed text, ranging in size from 2 to 12 points.

If 8-bit (grayscale) scanning is planned or if objective analysis of 1-bit or 8-bit scanning is desired, use spatial frequency response targets that facilitate objective evaluation. For information about such targets, see www.pima.net/standards/iso/tc42/wg18/WG18_POW.htm - 16067-2 for the slanted edge SFR target (EPS file) and www.pima.net/standards/iso/tc42/wg18/kp_sfr_measure.htm for background on targets for objective measurement of scanner/digital camera performance.

Reduction Ratio

As discussed above, choose the *lowest viable* reduction ratio, i.e., one that will produce sharp images, when filming in order to maximize the amount of detail captured by the film so that it can, in turn, be captured by a film scanner. Use a single reduction ratio for the entire reel if possible.

For an explanation on the interrelationship between reduction ratio, film resolution, and scanner capabilities, see Chapter 7, "Film Scanning," in Anne R. Kenney and Stephen Chapman's *Digital Imaging for Libraries and Archives*.[5]

Image Placement

The placement of images on microfilm contributes to the ease or difficulty of digitizing microfilm. Gross image placement is determined by the filming position used on the microfilm camera. Will the image be filmed so that the bottom edge of the source material is perpendicular to the long edge of the film (cine position, IA or IIA)? Or will the material be filmed so that the bottom edge is parallel to the long edge of the

[3] As with all targets used in photography or digital imaging, this target only measures performance of a system at the time that the image is captured. In other words, ensuring that this target meets an expected benchmark is not a substitute for objective or subjective evaluation of other images.

[4] E-mail communication from Stephen Chapman to Lars Meyer, September 20, 2002.

[5] Anne R. Kenney and Stephen Chapman, *Digital Imaging for Libraries and Archives* (Ithaca, NY: Dept. of Preservation and Conservation, Cornell University Library, 1996).

Table 1: Target Application Chart—Monographs

TARGET	FREQUENCY	TYPE OF PRODUCTION	MINIMUM TYPE SIZE	REQUIREMENTS
START Target	Per reel	Standard	Eye-legible	Required
Reel Guide	Per reel	Custom	Regular[6]	Optional
Master Neg Storage Number	Per title	Custom	Eye-legible	Required
Project ID Target	Per title	Project-specific	Large	Required
Copyright Statement	Per title	Project-specific	Large	Required
Title Target[1]	Per title	Custom	Eye-legible	Required
Bib Record Target	Per title	Custom	Regular	Required
List of Irregularities	Per title	Custom	Regular	Required if necessary
Optional Targets[2]	Per title	Standard	Eye-legible	Optional
Illumination Target	Per reel (or more often)	Standard	(n.a.)	Required
Technical Target (microfilm camera)	Per title	Standard[4]	(n.a.)	Required
Technical Target (microfilm scanner)	Per title	Standard[5]	(n.a.)	Required
Volume Target	Per volume	Standard	Eye-legible	Required if necessary
TEXT IS FILMED HERE				
In-Text/In-Frame Targets[3]				Not recommended
Continuation Target	Per reel	Standard	Eye-legible	Required if necessary
END Target	Per reel	Standard	Eye-legible	Required

[1] See the *RLG Preservation Microfilming Handbook*, Appendix 13, for more information on "Targeting Non-Latin Script Materials."
[2] See ALA Target Packet for sample optional targets.
[3] See Foldouts, below, on using in-text or in-frame targets.
[4] This target is used to assess the performance of the microfilm camera. Common examples include the QA-2, QA-3, or the Microcopy Test Target (designated as ANSI/ISO 3334 and ANSI/AIIM MS 51). If one title extends over an entire reel, the technical target must be filmed again between the end of the text and the continuation or END target.
[5] This target is used to assess the performance of the scanner's limiting resolution. Common examples include the RIT Alphanumeric Test Chart, the AIIM Scanner Test Chart #2, and the IEEE Facsimile Test Chart.
[6] If feasible, large type preferred.

Table 2: Target Application Chart—Serials

TARGET	FREQUENCY	TYPE OF PRODUCTION	MINIMUM TYPE SIZE	REQUIREMENTS
START Target	Per reel	Standard	Eye-legible	Required
Master Neg Storage Number	Per title	Custom	Eye-legible	Required
Project ID Target	Per title	Project-specific	Large	Required
Copyright Statement	Per title	Project-specific	Large	Required
Title Target[1]	Per title	Custom	Eye-legible	Required
Bib Record Target	Per title	Custom	Regular	Required
Guide to Contents	Per title	Custom	Regular[6]	Required/ Optional[7]
Reel Contents	Per reel	Custom	Eye-legible	Required
Optional Targets[2]	Per title	Standard	Eye-legible	Optional
Illumination Target	Per reel (or more often)	Standard	(n.a.)	Required
Technical Target (microfilm camera)	Per title	Standard[4]	(n.a.)	Required
Technical Target (microfilm scanner)	Per title	Standard[5]	(n.a.)	Required
Volume Target	Per volume	Standard	Eye-legible	Required if necessary
List of Irregularities	Per title	Custom	Regular	Required if necessary
TEXT IS FILMED HERE				
In-Text/In-Frame Targets[3]				Not recommended
Technical Target	Per reel (twice)	Standard	(n.a.)	Required
Continuation Target	Per reel	Standard	Eye-legible	Required if necessary
END Target	Per reel	Standard	Eye-legible	Required

[1] See the *RLG Preservation Microfilming Handbook*, Appendix 13, for more information on "Targeting Non-Latin Script Materials."
[2] See ALA Target Packet for sample optional targets.
[3] See Foldouts, below, on using in-text or in-frame targets.
[4] This target is used to assess the performance of the microfilm camera. Common examples include the QA-2, QA-3, or the Microcopy Test Target (designated as ANSI/ISO 3334 and ANSI/AIIM MS 51). If one title extends over an entire reel, the technical target must be filmed again between the end of the text and the continuation or END target.
[5] This target is used to assess the performance of the scanner's limiting resolution. Common examples include the RIT Alphanumeric Test Chart, the AIIM Scanner Test Chart #2, and the IEEE Facsimile Test Chart.
[6] If feasible, large type preferred.
[7] Required on first reel, optional on subsequent reels.

microfilm (comic position, IB or IIB)? Several factors contribute to reel programming decisions, including volume width, volume height, and the number of pages and targets that must be filmed (see Figure 1).

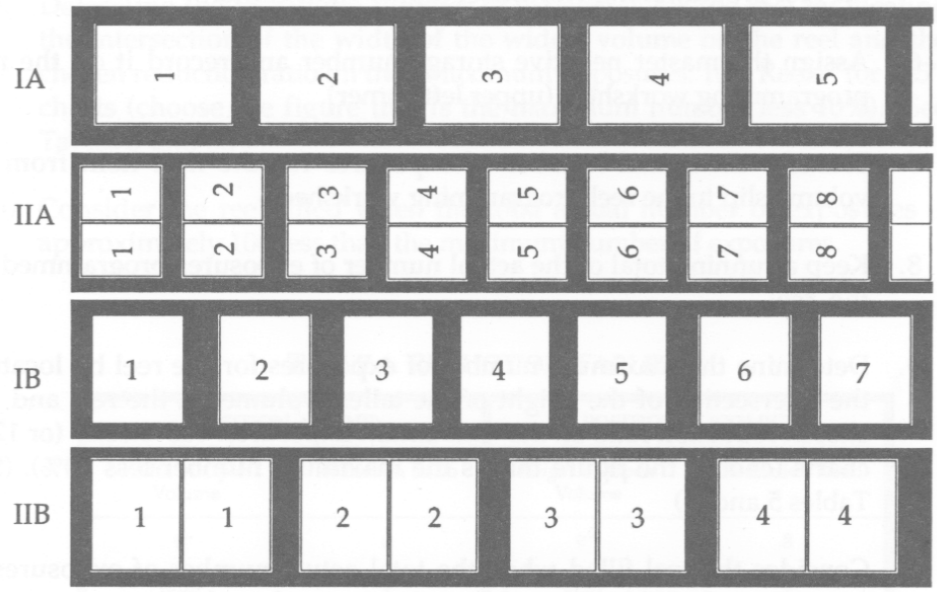

Figure 1: The four filming positions: IA, IIA, IB, IIB.[6]

Because digital images are normally presented a single page at a time, the imaging process must split images from film made with two pages per frame ("two-up"). Preferred image placement during filming is IA or IIA. IIA is viable because many scanners can bisect a two-up image longitudinally, scanning each half of the microfilm frame separately (and, incidentally, at a higher resolution than if scanning both halves in a single pass).[7] The bisected, single-page images can then be organized postscanning for presentation in proper order, a process often handled automatically by the software.

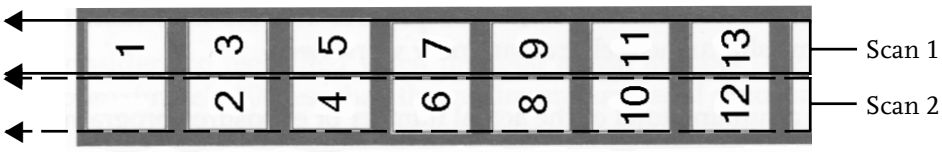

Figure 2: Bisection of microfilm filmed in IIA (cine) position.

Scanning film of materials filmed in IB or IIB position, especially at higher reduction ratios, could result in digital images that do not meet the requirements of the DLF

[6] Nancy E. Elkington, ed., *RLG Preservation Microfilming Handbook* (Mountain View, CA: Research Libraries Group, 1992), 133.

[7] Some film scanners use the same number of pixels to capture both the entire frame (IA) and the half frame (IIA), in which case the half frame is captured at almost twice the resolution as the entire frame.

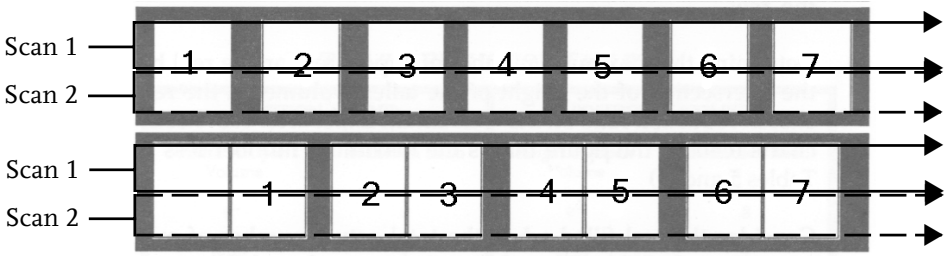

Figure 3: Possible bisection of microfilm filmed in B (comic) position.

benchmark if scanned by equipment that is unable to resolve all the details captured on the film in a single pass. To meet that benchmark, images filmed in IB or IIB may require scanning the microfilm frame in two passes that bisect each page.

Postscan processing would be required to stitch the segment images together again in order to present the image as a whole. In all likelihood this would be expensive. However, it may be unavoidable in cases where oversize materials require IIB filming in order to capture details inherent in the document.

Film Density

RLG guidelines have allowed density readings to deviate from average by no more than 0.20 across a reel. No modification is required to that guideline. Managers should note, however, that minimizing film density variation across all frames on a reel allows for more efficient film scanning by reducing the number of automatic or manual adjustments that have to be made to the scanner settings. To help minimize density variation, group materials during reel programming as outlined above.

Frame Detection at Time of Filming

Frame detection functions in automated microfilm scanning to assure that pages are captured correctly and entirely. Current microfilm scanners support many kinds of frame detection. Common methods include automatically identifying the leading and trailing edges of frames (in which case the entire frame is scanned, including the copyboard) or of documents (in which case only the document itself is scanned); recognizing blips (markers above and/or below each document and/or frame); and setting a fixed frame (where all frames are assumed to be of a uniform size). Each method has its drawbacks.

- Leading/trailing edge detection software can be confused by phenomena in the source materials such as changes in paper color or illustrations that contain features that might be misread as document edges.

- There are a number of blipping techniques and formats and unless it is known at the time of scanning which format the filming service used and what the blips were meant to indicate, blipping may be ineffective.

- The fixed frame method may be most reliable, but it requires that frames truly be regular in size and spaced uniformly on the reel. It also requires that microfilm cameras be in excellent working condition, since normal wear and tear on a camera's film advance mechanism may result in gradually increased spacing between frames.

When possible, to assist document edge detection during film scanning, repair torn corners, large cutouts, and holes during film preparation or collation with a paper that matches the original color of the source material. If repair is not a viable option, back or underlay the damaged source document with paper similar in color to the color of the source document at time of filming. This requires the camera operator to have paper of varying qualities accessible at all times.

Copyboard

The color of the copyboard should be considered in terms of the frame detection method that might be used during film scanning.

If leading/trailing edge detection of the *source documents* will be used, the copyboard should contrast with the color of the paper. For example, use a black copyboard for white paper.

If leading/trailing edge detection of the *frame* will be used, a copyboard that does not contrast with the background of the material should provide for more effective scanning. The camera aperture and a mask or gate are used to clearly delineate the edges of frames during scanning. This method may be labor intensive if the source documents are of different sizes, because the camera mask (or gate) would require constant readjustment.

Centerline Weave

Centerline weave is the drifting of the document across the film frame resulting from moving the volume off the centerline that bisects the length of the film. If the volume is filmed IIA and it is being scanned to capture a single page at a time, the centerline of the volume must not shift from frame to frame.

Gutter Shadow

Gutter shadow can interfere with automated film scanning or subsequent OCR processing. However, if centerline weave is eliminated and if frame detection is working properly or if fixed frame scanning is used, the effect of gutter shadow should be minimized.

The costs and benefits of eliminating gutter shadow at the time of filming should be weighed against the costs of removing gutter shadow during manual postscan image processing. Many modern camera and lighting configurations can reduce or eliminate gutter shadow. Institutions should check with filming services about the availability and added costs of using such systems. Disbinding also eliminates gutter shadow though it is obviously an option of last resort for many volumes.

Skew

RLG guidelines have so far allowed for image skew up to 10% or 9° from parallel with the longitudinal axis of the film. While most film produced, especially with newer equipment, never comes close to that range, tighter tolerances are mandatory when the microfilm is to be scanned.

Excessive skew can interfere with film scanner operation or require postscan processing time to correct. Therefore, skew should be kept to 2% or 2° from parallel.[8] It may be easiest to achieve this by disbinding the volume, if allowable.

If it is not possible to minimize skew to this benchmark because the volumes cannot be disbound or because the bindings cannot be adjusted without causing damage, problematic pages or sections should be noted at time of collation and verified at time of film inspection.

Blipping the microfilm frames of skewed pages is also an option. However, recording the location of skewed pages at time of collation or blipping during filming may only be useful if the film will be scanned shortly after filming is completed and it is known that the scanning service can use the blips or collation information to scan the film more efficiently.

Splices

Splices interfere with edge detection, and the presence of repeated pages might require manual deletion of redundant scanned images. If possible, eliminate splices on the microfilm within a given volume by having the entire volume refilmed when corrections must be made. If the added costs or extra wear placed on the volume by refilming cannot be justified, consider either blipping the splices or recording their location at the time of film inspection. However, these options may only be useful if the film will be scanned soon after microfilming is completed and if the scanning service can use the blips or inspection information to improve the efficiency of film scanning.

Intentional Second Exposures

RLG guidelines indicate that an intentional second exposure (ISE) should be made of pages with mixed text and halftone, continuous tone, or color graphic material. The first ISE should optimize the text and the second should optimize the image/illustration.

Since an ISE will require changing scanner settings to capture the optimal image, managers must determine if their presence should be recorded during collation (which requires the collator to have some knowledge of filming and requires the camera operator to indeed make the ISE), during filming by the camera operator, or during film inspection; or identified by a blip; or altogether ignored. This decision should be weighed against whether the technology and workflows employed to digitize the film can use the collation, inspection, or blip information to the improve efficiency of film scanning.

Foldouts

Foldouts that are larger than normal page size are problematic in film scanning because they interrupt the uniformity of the frames. Even foldouts that do not require a change in reduction ratio may be problematic. For example, if volumes filmed in IIA are scanned longitudinally one page at a time (as opposed to both pages at once) as described above, a foldout covering the width of two pages would be bisected during scanning because the scanner is set to capture only one-half of the microfilm frame.

[8] Anne R Kenney, "Planning for the Future: Film Digitization," in RLG Archives Microfilming Manual, ed Nancy E. Elkington (Mountain View, CA: Research Libraries Group, 1994), 98–99.

Use of a Ruler

When filming foldouts, do not film a stand-alone or in-frame target that indicates a change in reduction ratio. Instead, note the foldout as part of the initial target sequence, and film a ruler on the copyboard at the bottom edge of the frame, leaving a space of at least .5 inches between the document and the ruler. Likewise, leave at least .5 inches between the ruler and the edge of the film frame.[9] The ruler will help users of the microfilm visualize the original size of the foldout. Moreover, the ruler will be useful in determining the effective resolution of the digitized foldout and assist in scaling the image to original size for printing. The scanning technician will have to be alerted to these frames either with the aid of film collation/inspection data or through blips.

The film scanner will require adjustment to capture the ruler on the copyboard. Moreover, the ruler may confuse edge detection software, especially if the color of the background contrasts with the source materials. To avoid this, the foldout could be filmed on a background that does not contrast in color with the source materials. The background should be large enough to include the foldout and the ruler. In this case, the edge detection software will still detect the edge of the copyboard but the scanner will capture the noncontrasting background along with the foldout and the ruler. Although this captures an image larger than the foldout, it does allow for automated edge detection. Obviously, changing the background for one page reduces filming efficiency.

Placement of oversize foldouts on the film can vary.

1. In some cases, all of the significant details of a foldout can be fully captured in a single frame at a higher reduction ratio, both by the film camera and by the scanner. However, while a microfilm camera may be capable of capturing all the details of a foldout at a higher reduction ratio, a film scanner may not. Institutions should check with their filming and scanning services about specific capabilities before selecting this option. If the details in the foldout cannot be *fully* captured in a single frame, choose one of the following options.

2. Film a single page-size portion of the foldout at the same reduction ratio as other pages and then film the entire foldout at the end of the volume, first as a single image at a higher reduction ratio that captures the foldout in its entirety and then in sections at as low a reduction ratio as needed to capture the details adequately. This practice should be signaled to the microfilm user and scanning technician by an explanatory target filmed as part of the target start sequence. Optionally, a note placed over the partially exposed foldout can also alert the reader to go to the end of the volume to see the foldout.

3. Simply film the foldout at the end of the reel. Alert the reader to its location as in option 2. Note that options 2 and 3 both expedite the scanning process but inconvenience film users.

4. Film the foldout where it appears in the volume, first at a reduction ratio that captures the entire foldout and then in sections at a lower reduction ratio. This procedure will, however, disrupt the automated scanning process.

[9] The ruler can be placed along another edge of the frame if necessary. Filmers should consult with their clients before doing so. In addition, the alternative placement of the ruler should be documented by the filmer.

As explained in Reel Programming, above, it may be best to aggregate all materials with foldouts and program those volumes onto their own reel. Again, this is not recommended for serial volumes with foldouts; serial volumes should not be filmed out of sequence.

The presence of foldouts should be noted at time of collation and/or inspection. Foldouts could also be blipped. Recording this information or blipping the film may only be useful if the equipment used to scan the film can capitalize on that data.

Frame Indexing

Some microfilm camera systems can automatically record sequential frame numbers, optical codes (blips), and other human- or machine-readable data to identify document features or to indicate changes in scanner settings. This data may enable automatic adjustments to the film scanner. It may also be possible to manipulate some data captured during the scanning process to generate metadata useful in postscan processing of the digital images. Frame indexing uses space on the film, however, requiring source documents to be filmed at a slightly higher reduction ratio than is otherwise necessary.

Institutions should consider the costs and benefits. Recording roll number and frame number in each frame may be useful even if the decision to scan the film has not been made. On the other hand, blips, barcodes, or other signals that can be interpreted only by a specific hardware and software configuration should be avoided unless scanning will immediately follow filming.[10] If included, the indexing signals should appear in a *consistent* location and in a uniform format throughout.

Film Inspection

Depending on the nature of the project, it may be worth the time during film inspection to record additional data about features in a volume or frames on a reel that will require special scanning procedures. The data collected here can complement the data collected during collation. However, as is the case with collecting data about a volume's features during collation, the costs of doing so during inspection must be weighed against the benefits. Benefits will be realized only if collation and inspection data will be useful in creating or complementing structural metadata and/or assisting the scanning technician.

For example, if the filming/scanning effort includes a step in which all halftone, continuous-tone, and color images will be replaced by images that meet DLF benchmarks, the collation/inspection sheet can help identify the pages that need to be scanned directly.

[10] Currently, there are no industry standards for barcoding. See ANSI/AIIM MS8-1988 Image Mark (Blip) Used in Image Mark Retrieval Systems for more information on blipping. For examples on frame indexing, see Hartmut Weber and Marianne Dörr, *Digitization as a Method of Preservation? Final Report of the Working Group of the Deutsche Forschungsgemeinschaft (German Research Association)* (Washington, DC: Commission on Preservation and Access, 1997), 7–8.

The collation/inspection sheet can be annotated during digital image quality control. The image inspector can refer to the inspection sheet to determine whether a poor digital image is the result of limitations inherent in the source materials, of filming error, or of problems in film scanning.

Conclusion

Preservation microfilm manufactured according to current standards and guidelines will produce film that can be digitized by most services. However, microfilm made by following some or all of these additional guidelines will be significantly more amenable to scanning, although its production may be more labor intensive.

If institutions are committed to scanning their film, they must negotiate carefully with both filming and scanning services to determine capabilities (dependent in some part on the available technology), costs, and specific practices for implementing and capitalizing on the changes suggested by these guidelines.

Institutions and services are encouraged to share their experiences and direct suggestions for changes or additions to the guidelines to Robin Dale at RLG (robin.dale@notes.rlg.org).

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