Digital Library Initiative

Fondren Library, Rice University

Image Capture Process

Guidelines for Digital Projects

Contact: dli (at) rice (dot) edu

authored by

Monica Rivero, Digital Projects Manager

technical contributors

Dean Davis, Senior Project Assistant
Jane Zhao, Digital Media Center, Manager

Version 2.0, January 2008

Prelude

Any documentation effort is in part an attempt to capture organizational knowledge and as such is an endeavor that builds on those that came before.

We wish to especially thank the following individuals for their support and for generously contributing their insight on digital library practices and related technologies.

- Geneva Henry, Digital Library Initiative Exec. Director
- Amanda Focke, Asst. Head of Special Collections
- Lisa Spiro, Director of Digital Media Center
- Andy Damico, Preservation Librarian
- Sid Byrd, Sys Admin / Dspace Programmer

Please note that this document is based in part on earlier documentation compiled from the following contributors:

Marie Weis, TIMEA project manager – workflow and technical guidelines
Eric Leshinsky, scanning operator and Rice grad student – quality controls guidelines

And our own internal (and evolving) operational practices, which included major testing and analysis efforts from:

- Dean Davis, Senior Project Assistant
- Jane Zhao, Digital Media Specialist

Table of Contents

Introduction **2**
Purpose 2
Description of typical scanning work 2
Version 2
Best practices **2**
Project management **3**
Pre-startup review 3
Scheduling 3
Reporting 4
Technical infrastructure **4**
System description 4
Table of system specs 5
Supplemental information on system components 5
Digital objects 6
File specifications 7
File naming conventions 8
File management 10
Quality controls **11**
Quality control measures 11
Quality assessment 11
Resolution 12
Color management 12
Post-scanning review 13
Image editing 14
Technical metadata **14**
Workflow **18**
Operational Instructions 18
Basic Workflow 18
Maintenance and tips 20
Quality controls - quick reference 23
Derivatives 24
Technical Support 24
Future activities **25**
Appendix **26**
Care and handling of original materials 26
Resources 27

Introduction

Purpose

The ultimate purpose of our image-capture process for digital projects is the creation of preservation quality digital images and producing derivatives from these master versions for general dissimilation.

Documentation serves an integral part of planning as it provides the guidelines and measures by which a project is executed. It ensures the tactic steps are aligned with overall project goals. The purpose of these guidelines is to provide the necessary documentation for the creation of digital images in Fondren's digital collections in accordance with professional standards and best practices within the imaging and library communities.

This document will define quality targets and file specifications, provide a general description of the technical system itself and provide detail instructions on the operation of equipment and software. Also provided are suggested practices for managing project workflow and recommendations for compiling and tracking technical metadata.

Description of typical scanning work

These guidelines focus on textual materials and flat artworks. Materials are primarily archival documents such as rare books, manuscripts, photographs and other types of bound documents such as journals and pamphlets. In general, the physical size range is within what is normally considered traditional paper size. On occasion scanning work may include some oversized items such as broadsheets, posters and maps.

Version

This is the second version of documentation for image capture process by the Fondren Digital Library Initiative. One of our goals is to compile the various guidelines and instructions created during past projects into a single self-contained document. Another goal is to document modifications to our practices based on a recent systematic process review that was performed in preparation for the startup of a major digitization project, *Our Americas Archive Partnership (OAAP)*[1].

Best practices

These guidelines aim to meet or exceed benchmarks set forth by the Digital Library Federation:

> Benchmark for Faithful Digital Reproductions of Monographs and Serials. Digital Library Federation. Version 1. December 2002. http://www.diglib.org/standards/bmarkfin.htm

This DLF document provides guidelines regarding general principles of completeness, accuracy, and consistency in defining what is a faithful reproduction. It also recommends that a

[1] For more information regarding OAAP, please see project profile

digital product should include appropriate metadata, text encoding if applicable, and that a persistent citable location is provide for the final product.

For additional best practices and standards used to create our internal practices please see the resource list in appendix of this document.

Project management

An overview of general digital project management, recommended practices and other related digital collection information are available online at the DLI documentation site. This site includes various templates and guidelines. Below are some additional suggestions for planning and implementing an image based digital project.

Pre-startup review

A suggested practice is to perform a review of the physical collection prior to beginning the scanning process. The purpose of this review is to identify any fragile items that may need special treatment prior to scanning and to identify key physical attributes of the materials themselves.

Key attributes may include:

- Printed or handwritten text
- Bound or loose leave pages
- Oversized or fragile items
- Primarily graphic items (such as maps, photographs or works of art)
- Language
- Page count

This information should be gathered at the item level. Such physical attributes are factors that will impact schedule planning and aid in estimating the digitization timeline. It is also important to identify any potential restrictions to access due to copyright or pre-existing donor agreements. Optionally, one may also wish to identify any items of intellectual or artistic interest that could be used for marketing purposes.

Scheduling

Material attributes gathered during the pre-startup review can be used to develop the scanning schedule. A typical document can be scanned at anywhere from 10-15 pages per hour for our current system and setup. This rate is dependent on the physical nature of the object being scanned and technical specifications appropriate for said object. Because the BetterLight camera scans side-to-side, only horizontal dimensions effect scanning time; however, because bound materials are positioned side-on, this usually corresponds to the vertical length of the document. More tightly bound or delicate books, or materials with unusual pages (for example, fold-out pictures), will also require more setup time to ensure proper handling and adequate production quality. A rough estimate then is approximately 120 pages per day, with color or graphically dense documents requiring additional time for setup and configuration.

A common practice to streamline processing time is to scan similar materials in batches as this reduces the overall time in calibrating the system since similar materials will tend to use similar settings. However this practice should be balanced with overall project tasks. For example there are a number of downstream project tasks such as transcriptions, translations, text mark

up and preparation of scholarly introductions that may be dependent upon having the digital images to work from. Therefore a final schedule should factor in these needs as well and it is recommended to schedule a cross-section of material types throughout the life of the project.

Reporting

The detail progress of digital file creation is tracked in the technical metadata worksheet. The storage/folder arrangement of images on the file server is separated into the key phases in the production cycle of digital image creation. This arrangement easily allows one to gauge the overall work status. It also provides a separate folder to gather files that are ready for batch upload by derivative and identifier. (Please see file management section for fuller explanation.)

Therefore from this combination of folder management and tracking spreadsheet, a project manager should be able to provide the production status of the project at any particular point in time. Typical information may include:

- Total number of master files created
- Total number of objects created
- Number of works in progress (items pending quality control, derivatives status, etc)
- Percent completion of total project

Additional analysis of the above data can be used in evaluation of product commitments verse actual production and monitoring of the overall project timeline.

Technical infrastructure

System description

The Digital Library Initiative at Fondren Library uses a Better Light Super 8K2 scanning back system. (Sometimes referred to as “the scanner” or “scan-back”) The actual image capture process uses a combination of various equipment and software. This system is composed of a professional grade digital camera, copy stand, book cradle, halogen lighting, and specially developed software.

Linear CCD (Charge-Coupled Device) array technology is the basis of the scan-back system and allows for a powerful level of resolution control and color-depth information to be captured. In general, the greater the information, the sharper and more detailed the image and thereby the more visually accurate the reproduction.

It’s important to note that scan-back systems are highly sensitive to light and require a continuous, flicker-free lighting environment to ensure consistency and high quality of image captured.

Another important aspect of the scan-back system is that it minimizes care and handling of physical items. Devices such as the copy stand and book cradle allow for the careful placement of sometimes fragile and or delicate archival materials. For instance tightly bound items may be secured gently and partially held open during scanning thereby reducing stress to the physical item and minimizing human handling.

Scan-back: A linear (or tri-linear) array CCD, which digitally records (i.e. "scans") an image three times, each in a different color filter (red, green and blue). This type of system requires a high level of lighting and longer exposure time than smaller scale scanners or cameras. They are typically used for still-life imaging in the commercial, museum and art areas.[2]

Table of system specs

System[3]	TTI Better Light Super 8K2 digital scanning back, copy stand, book cradle, lighting, and camera.
Hardware	Mac computer: PowerPC G5 OSx 10.3.9 Dual 2.5Ghz RAM:2 GB memory with USB connection
Camera	TTI Reflex 45ei (4x5 view camera)
Lens	Rodenstock Apo-sironar digital f=90mm With Infrared Blocking Filters 77 mm
Light source	Tarsia tungstens - Reflective Lighting halogen lamp, stand alone model TTI 2000W
Color management	adobeRGB1998 or Custom color profile[4] match to Macbeth Color Checker™
Monitor calibration	Eye-One Match, display 2
Software	o Better Light Viewfinder 7 o Photoshop C52 o IrfanView

Supplemental information on system components

Light source

The tungsten lights consume high levels of AC power and generate a great deal of heat.[5] These types of lights can reach full output capacity within a few seconds which is a unique feature of these types of lights and fulfills a pre-start up requirement for good practices in digital image processing. They are also the most economical lighting option and are designed to protect media from IR and UV light[6].

[2] Davis P26, 36-37
[3] Technical Specification sheets can be found on the Tarsia Technical Industries web site:
Camera – http://www.ttind.com/TTIReflex45eiSheet.pdf
Lighting – http://www.ttind.com/ReflectiveLighting.pdf
[4] For further information on color management techniques, please see quality control section
[5] What kinds of lighting can be used with a scanning back? http://www.betterlight.com/faq_sales.html#faq9
[6] http://www.ttind.com

Infrared Blocking Filter

Infrared (IR) Blocking Filter (77 mm) is a blue-green round filter which is necessary to block infrared lighting and reduce haze. Without this IR filter, scans may appear with a purple to red cast. The 3mm thickness is recommended with tungstens light source. This filter screws on to the outside of camera lens.

Software

Better Light Viewfinder[7] 7 – primary image capture software (proprietary).

Photoshop C52 – used in post scanning work such as sampling for quality assurance, rotation for page orientation, etc.

IrfanView[8] – freeware graphic viewer used for batch converting master to derivative files. Also used when appropriate for mass filename conversions.

History of Betterlight Decision

"In our proposal for the Travelers in the Middle East Archive, we had proposed to buy a book scanner for digitizing books, and to count the cost of this scanner towards cost-share. However, a comment from a grant reviewer and discussions with colleagues convinced us that it would be preferable to purchase a professional reprographic stand scan-back system. After performing some research, we determined that there were two main choices for digital scanning backs: Phase One and Betterlight. We contacted colleagues at IBM, University of Pennsylvania, Dallas Museum of Art, and NYU to determine what system to purchase and who to purchase it from. According to our colleagues, Betterlight would provide not only a superior system, but much better technical support. (The only drawback to the Betterlight system was that it interpolated pixels at resolutions above 100%, which we determined would not be an issue for us.) We compared estimates from two of the leading companies selling these systems and determined both that there were no significant cost differences and that TTI had a strong reputation and deep technical expertise. We purchased a system from TTI that included a Betterlight 8k scanning back, Rodenstock lens, TTI copy stand, TTI-modified book cradle, and a pair of light stands with tungsten lights. The system has performed well for over two and a half years and, true to its reputation, Betterlight has delivered exceptional customer support"[9].

Digital objects

For our internal purposes, a digital object is generally defined as the electronic equivalent of a physical document. Though there may be cases were an item defined at the physical level correlates to multiple items in the digital environment. For example an archival finding aid may document an item comprised of individual letters in a single correspondence folder or multiple photos may be placed in a single album. Electronically these various letters and photos could be treated as individual digital items each with their own unique metadata and id. The digital

[7] Online tutorials, descriptions of controls and display see http://www.betterlight.com/viewFinder.html
[8] Downloadable from http://www.irfanview.com/
[9] Quoted from Lisa Spiro, Director, Digital Media Center

environment, given the flexibility of arrangement available and increased searching functionality, encourages a greater sharing of information. So whenever feasible (economically and technically), it is recommended to define objects at a more granular level. This practice ultimately supports discovery of relevant materials for the end-user by providing access to materials in a detailed fashion.

Best practices recommend identifying digital resources "by means of a string or number conforming to a formal identification system"[10] This is similar in concept to using ISBN numbers for print materials. At a repository level, Rice uses the handle system (http://www.handle.net/) to provide persistent url identifiers to final online resources. A complete digital resource includes the digital page images, related metadata, and if appropriate text markup.

File specifications

General factors for selection of file formats that impact sustainability and end-users access[11]:

- cross platform compatibility
- open or non-proprietary
- well documented and widely supported

Since the primary goal in the digital capture process is to achieve a faithful representation of the original artifact, file formats should also be capable of retaining the necessary characteristics for rendering quality images. Such factors for still images include[12]:

- Clarity (support for high image resolution)
- Color maintenance (support for color management)
- Support for graphic effects and typography

Supporting the above mentioned factors, the de-facto standard for still-image files in the library community is the TIFF format for masters and JPEG for access copies.

The following table outlines the specific formats and desired settings for digital images produced for digital projects at Rice.

Version	Quality	Bit depth	Resolution	File format
Master	Preservation	24 bit RBG-color	400 dpi for text 600 dpi for graphically intense images	TIFF
Derivative	Access		long dimension set to 1024 pixels	JPEG
Thumbnail			set to 96 pixel height	GIF

[10] CDPDCMBP http://www.cdpheritage.org/cdp/documents/CDPDCMBP.pdf (p48)
[11] NARA http://www.archives.gov/preservation/technical/guidelines.html p60
[12] Arms http://www.digitalpreservation.gov/formats/index.shtml

Practical applications

Master Files: In selecting the appropriate dpi for pages with mixed content (i.e. text verse graphic dpi rate) as a general rule of thumb: if the image is greater than 50% of the page, use the 600dpi. However, if the image is graphically intense regardless to its size in proportion to the total page, use the 600dpi rate in order to adequately capture image details.

In the creation of derivative images, certain materials may require special treatment based either on their physical dimensions or nature of work. Examples include maps, large format documents or non-standard formatted pages (pull outs). In such instances, testing should be done on a case by case basis to determine an appropriate resolution rate for these types of materials.

File naming conventions

In the simplest sense, naming conventions serve as labels for digital files. These conventions should lend themselves to be applied in a systematic and consistent manner. Our current practice is to defined specific naming conventions at a project level. Such schema should be determined prior to the digital capture process starts and an outline provided to the scanning operator.

There are a number of good and general practices in forming naming schemas that can be applied across projects and are listed below: [13] [14] [15].

Required:

- Each digital file should have a unique identifier
- The schema should provide a logical sequence that can be easily identified and reproduced
- A uniform naming convention should be applied within a collection or project
- Follow good practices for selection of characters in creating file names. These include: no blank spaces, no special symbol characters (i.e. any characters typically used in programming language), consistently apply case (e.g. all small or “camel” format), and the use of leading zeros for numeric driven schema
- Take into account the maximum number of items to be scanned
- Do not use an overly complex or lengthy naming scheme that is susceptible to human error during manual input.

Recommended

An important consideration in defining file naming conventions is the multipart object. A digital object may be composed of multiple image files where each file represents one-side of a

[13] NARA http://www.archives.gov/preservation/technical/guidelines.html (p60)
[14] www.loc.gov/standards/mets/presentations/goettingen.ppt (slide 23)
[15] CDPDCMBP http://www.cdpheritage.org/cdp/documents/CDPDCMBP.pdf (p48)

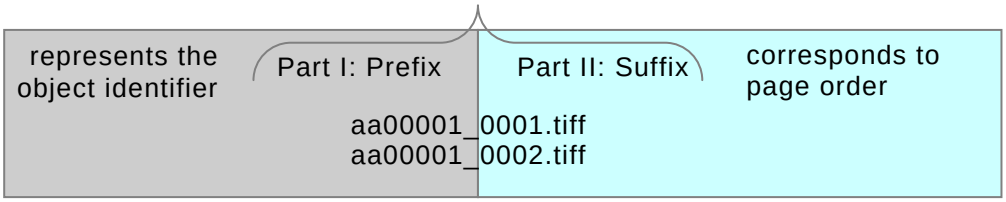
physical page and as a group comprises one record in the data repository system. For instance a book containing hundreds of pages is treated as one item in the data repository.

image files + metadata = 1 record

For the purposes of managing the digital creation process, which includes a level of manual tracking, a naming conversion that provides some level of administrative information is very helpful if not outright necessary. This is especially true in multipart objects to ensure pagination is maintained for accurate display and navigation in the final presentation.

Therefore digital file names can be setup to be composed of two parts: 1) having the same prefix number to represent the object level and 2) combined with a suffix number to represent a particular page image and its order. This method captures the basic structure of an object where the roll up of individual files is apparent from the file name. This method greatly aids in organizing the structure of digital files into one seamless object and impacts downstream workflow digitization processes, such as text mark.

Example: Complete digital file name



- For multipart objects, it is recommended to use a two-part naming convention that tracks the page sequence as well as object level.

Optional practice

- Use of codes to represent department or collection.

  Examples:

  wrcXXX_001.tiff Woodson Research Center

  ssm00001a001.wav Shepherd School of Music

  Viewing data from a holistic approach, having individual files with a component of their identifiers to denote sub communities or collections can aid in the overall management of files particularly when multiple projects are being worked simultaneously or in collaborative projects with multiple partner institutions. However, this practice does add on to the overall length of filenames and for stand alone projects may be more cumbersome than is beneficial.

File extensions

Naming conventions should be applied consistently to an individual digital object regardless to file format. In this manner masters and derivatives that represent the same physical item will both have the same identifier but are distinguished by the appropriate file extension type. In the below example only the extension has changed; identifiers remain constant per digital representation.

Example: Different digital versions of same page image

wrcXXX_001.**tiff**	Master	same identifier, different extension
wrcXXX_001.**jpg**	Derivative	

Naming convention

From a project management perspective, the file naming convention is an important consideration in planning the digital creation process. The ease of use or practicality of the naming convention impacts compilers of digital objects on a daily basis from scanning operators during the image capture process to encoding work during text markup. As a general rule of thumb, the simpler a naming scheme is to form, the easier it is to manage and communicate. And thereby the less likely rework and confusion will result. As our ultimate (or final) identifier is based on the handle system and assign at the end of the process, the file name is actually a temporary id used during the product development stage. As such the file naming convention serves a dual purpose not only to uniquely identify but as an aid for manually tracking digital objects until these objects are ready for ingest into the repository.

File management

The process of digitization requires a mechanism for tracking the progress of creation at different stages of the production cycle. One simple, though manual, practice to achieve this goal is through the organization of project files and server folders. The organization of folders and files can follow a simple tree structure. A basic organization is to begin with a main folder (named for the project, collection or department) with sub folders for major phases or types of digital records such as a master image folder and individual object folders containing access versions of images.

Project files include the digitalized page images themselves (masters and derivative variants); excel tracking worksheets (technical metadata) plus other files providing description information such as XML documents such as text marked up documents (e.g. TEI files) or metadata records (e.g. MODS xml files). All these files should be permanently stored on the image file server[16].

Server on BetterLight Scan Back system

"Better Light scan-backs include a dedicated disk drive in the control box where image data is stored during each scan. Images are saved as standard TIFF files with either 8 or 16 bits per channel of monochrome or RGB data. Image files can be selected and retrieved to any available storage medium in the host computer. Once in the host computer, these TIFF files can be viewed using a high-performance image editing application such as Adobe Photoshop" [17]

Our practice requires transferring master files from local workstation to the image server at end of each work session. This will ensure that master files are backed up and centrally accessible.

---

[16] The image file server is a dedicated server for digital projects containing the DSpace program itself as well as image files and various project working papers. This server is backed up routinely by campus IT.
[17] http://www.betterlight.com/

Quality controls

In general quality control is the practice of applying consistent measures to the digital imaging process that will ensure clarity of the image and visual faithfulness to the original document. These practices should include image capture guidelines, documentation (metadata) and maintenance.[18]

Quality control measures

- Digitize page images at close match to dimensions of the original pages
- Scan the whole image area (with edges) and ensure that no cropping of image itself has occurred
- Scan the complete document including reverse side of pages, front and back matter, blank pages, hard coverings, spine, etc
- Validate that all pages are turned to their proper orientation
- Proper resolution has been used when scanning each page (DPI: 600 image, 400 text)
- Capture technical metadata at time of scan (see metadata section for fuller explanation)
- Perform visual comparison of digitized images with original document
- Visually check for any missing or mislabeled pages
- Visually check that no distortion or blemishes obscure the legibility due to photo processing (i.e. that a blemish is not part of the original text and or any glare from protective covering is minimized)
- Compare count of actual digital images with estimated page count (if a preliminary audit was completed prior to project start up); this is a technique used as a general check for completeness.
- Color management (use appropriate color profile)
- Monitor calibration (regularly perform)
- Apply consistent file naming scheme (as defined per project)

Quality assessment

Quality assessments are the procedures used to check the quality of final product.[19] These procedures include objective system capture parameters and file specifications as well as subjective measures such as visually viewing images for legibility and clarity. We aim for a consistent approach that is reproducible and trainable to operators with little prior digital media experience. In assessing image quality the key factors are resolution, color management and overall appearance[20].

Guidelines for metadata capture and equipment maintenance are covered in subsequent sections. The technical metadata section contains parameters with hard targets to achieve the goal of creating preservation level master image files. The maintenance section outlines routine calibration of critical equipment.

---

[18] Howard. See quality control section. http://www.getty.edu/research/conducting_research/standards/introimages/intro.html
[19] NINCH http://www.nyu.edu/its/humanities/ninchguide/VII
[20] Cornell p50

Resolution

The term resolution is used to define different types of quality[21].

- Resolution (color) – bit depth
- Resolution (optical) – DPI
- Resolution (spatial) – image size

Bit depth

Bit depth is a measurement of color quality. The optimal setting for types of materials captured is 24 bit depth. This gives a maximum possible values of 2^24 or over 16MM possible colors.

DPI

Set at either 400dpi for text or 600dpi for images[22].

> **Note**: DPI (Dots per inch) is a term commonly used interchangeably with PPI (pixels per inch). Though technically speaking the resolution of a digital image is in pixels rather than inches. DPI is sometimes used in as a measurement for an output device such as a printer.

Spatial

Both the overall scan time and the resulting image size will be affected by changes to the selected resolution. We assign an acceptable range from 50% for text through 75% for images. This resolution percentage is a component specific to the betterlight scan back system. The settings (%) is dependent on the model of camera insert and these selections are evenly spaced by percent. Therefore an exact image output size cannot be obtained at one of the available resolution selections, it is recommended to select a resolution that produces a file larger than needed, providing that resolution does not exceed 100%[23].

Color management

The goal of color management system (CMS) software is to ensure that the colors of the original match as precisely as possible the digital reproduction on-screen.[24] We use the Macbeth Color Checker™ to maintain consistence color matching; Perform periodic white balance test to ensure well balance of lighting on image capture area; and embed color profiles per image.

---

[21] Davis p199
[22] DLF http://www.diglib.org/standards/bmarkfin.htm
[23] Viewfinder manual p25
[24] Cornell http://www.library.cornell.edu/preservation/tutorial/quality/quality-02.html

Color profiles

For documents whose information is primarily textual in nature, we use the adobeRGB1998 international standard. Textual materials include books, manuscripts, journals and any printed documents. Using this standard provides a consistent tonality to multiple page objects (which custom icc tend not to provide and was a major quality control issue in the past).

For documents whose information is primarily of a graphical or visual nature, that is when critical color matching is inherently important to the understanding of the document, then we use a custom color profile. Visual materials may include maps, photographs, and artwork.

Tone curve profile

Tonal adjustments are most often used to make changes in the overall contrast range of an image. We use the Repro 2.2 v2 profile as recommended by imagining specialists. Testing has verified that custom created tonal curves do not noticeably improve appearance of images.

Monitor calibration

Color matching with the naked eye is not an accurate or consistent method as various factors may influence color determination such as ambient lighting, an individual's color perceptions and changes in the viewing environment. Therefore an objective calibration is necessary in order to determine how color is rendered on screen from the input devise (camera) and video card. The Eye-One Match, display 2 is a color measurement device (spectrophotometer) and software used to calibrate the monitor and create a monitor profile. It adjusts the actual monitor output to a standard color temperature and gamma setting for a consistent and accurate color capture. "GretagMacbeth suggest that Eye-One Monitor is best suited to users who mainly work with images and graphics destined for use on the Internet or simple AV presentations."[25] Monitor calibration is preformed at least monthly.

Post-scanning review

Visual Inspection is performed on 100% of scanned master files. Each item is examined for completeness, consistency of quality across object, clarity and page orientation. A post-scanning review ensures accuracy of technical specifications are within established project parameters. Alternatively a random sampling may be done on at least 10%[26] of page images (files) per digital object to closely validate each technical specification.

Re-scanning

Re-scanning may be deemed necessary following a post-scan review. Re-scanning may result from a desire to improve an initial scan quality or capture any missing pages. In such cases, it is important to match tone and color of existing pages when creating the new image to maintain a consistency of overall image quality throughout the digital object. The operator should review the original settings and match these specifications (including resolution, camera position and ISO settings) when preparing the new scan. A visual comparison to preceding and sequential pages is also recommended.

[25] Eye-One Monitor Review http://www.computer-darkroom.com/ione/ione-1.htm
[26] NARA http://www.archives.gov/preservation/technical/guidelines.html (p62)

Re-labeling

A basic premise of a file naming convention is to reflect the actual page order of the original document (see recommendations section under file naming conventions). While scanning particularly long documents or when more than one operator may be working on a particular document, is that sometimes file names are inadvertently assigned out of sequence. When this occurs, we termed these files as “mislabeled”. Re-labeling of images is then necessary to correct the ordering of images so that the filenames correspond to the actual page sequence of original document.

Image editing

To ensure a visually faithful representation of the original artifact is achieved, our current practice is not to digitally manipulate master files through post-scan processing. In this context, post-scan processing refers to any adjustments made to enhance a digital image through software editing tools such as Photoshop.

An alternative school of thought is to produce RAW and Enhanced master versions of image files. There may be legitimate reasons for such adjustments. Based on the general idea that information exists on the original artifact that is not clearly visual without enhancement. Perhaps similar in concept to restoration work on physical art objects, a good example of this practice is taking clouded old photographs and digitally altering the image to produce a clearer image without touching the physical item.

Without making a judgment call as to the validity of this approach in an archival repository, there are apparent factors that come into play:

- Requires advance knowledge of Photoshop to apply techniques and which may result in additional operator training needs
- Requires additional processing time to produce
- Results in additional storage and management needs
- Requires proper equipment and monitor calibration
- Enhancements are subjective in nature and difficult to qualify general standards

However, the additional time and overall subjective nature of such enhancements makes this approach cost prohibitive to implement on a mass basis. Though there seems to be certain types of collections that may benefit more from this practice than others, for example photographic vs. textual media based collections. Our current practice is to determine if digital restoration is appropriate on a case-by-case basis.

Technical metadata

A primary objective for technical metadata is assurance of quality control and tracking the progress of digital object development. Technical metadata is captured at the most detail level, the individual image file. Our internal practice is to have a separate tracking worksheet per digital project. The working copy of the metadata file resides on the local computer attached to the scan-back system and a copy is transferred to the file server at the end of each work day. As the file server is backed up regularly, final copies should always be transferred to this server.

Each row in the spreadsheet represents a unique digital image file. A blank template is available here at the DLI documentation page [template_metadata_technical.xls]. The following list provides a description of each metadata element and their data content targets.

ID

Number assigned by operator in sequential scanning order

Identifier

Unique alphanumeric number per digital object as defined by individual project. (See naming convention section – object identifiers)

Page

Page notation from physical item. The stated page notations on materials may vary from text to text or even within the same text; some using roman characters or are not labeled at all (such as is the case with some handwritten manuscripts); some materials restart pagination at certain sections within the text. This page information therefore is generally helpful to the operator in matching the stated page sequence to the actual page sequence in validating the digital filename, regardless to what may be printed or labeled on the physical item.

File name

Unique alphanumeric number per digital file as defined by individual project. Manually applied by operator. (See naming convention section for proper file naming practices.)

Date

date of digital image file is created. Use the standard Date and Time Formats (W3C-DTF) http://www.w3.org/TR/NOTE-datetime. Use format YYYY-MM-DD. Since a digital product may be comprised of multiple files, the start and finish dates may span multiple days.

Operator

Name of student creating scan. Rice practice is to hire student-workers for scanning work. Students are given specific training in use of the scan-back system.

Type

Refers to the document's content at the individual page level. Typical value is either text or image. This value determines the technical specifications that should be applied for image capture (see file specifications section regarding DPI). Use controlled vocabulary terms from the DCMI type vocabulary http://dublincore.org/documents/dcmi-type-vocabulary/

Source

Value corresponds to the library location of the physical document; can be an item's call number or location in archives such as box/folder/item notation. Identifying this location will allow for easier retrieve if post-production review requires a re-look at the original item to address questions of quality, page order, etc.

Size

Size in inches of the digital image.

The general goal is to have a 1:1 ratio between the digital image and physical document. For oversized items, however a balance between the quality of the image and resulting digital size may result in a less than 1:1 ratio. This is due to limitation of space between the camera, focus (ie zooming out to capture the complete page of the item or positioning the camera further away from the item) and desired resolution. When larger items do not fit within the angle of the possible camera range, some digital manipulation may be needed resulting in smaller digital dimension than physical size.

Bit depth

Fixed Value: 24 bit

DPI

400dpi for text or 600dpi for images. (see file specifications section for guidance)

Resolution

Acceptable range: 50% for text through 75% for images

The term "resolution" is specific to the viewfinder software. Though the term "resolution" can apply to many different parameters – see quality control section.

F Stop

Fixed Value: 8

F-stop is the amount of light which passes through the lens to the CCD and is determined by the shudder sped of the camera lens. Lens speed is calibrated in f-stops with the smaller the f-stop value the faster the shudder sped and hence the greater the light is exposed to the image. This is manual adjustment directly set on the better light scan back system itself and not a software value.

Camera position

range baseline: 980-990

Camera position effects depth of field or focus. The general practice is to keep a consistent setting within a single scan job (book, pamphlet, series of photographs). This allows for a

constant tonality across pages images within one particular digital document. Since settings for similar media size objects will tend to have similar settings, a rule of thumb is to use a value with in the range 980-990 (approx) for regular size documents. (Lower values for smaller materials, higher values for large format materials). This is manual adjustment directly set on the better light scan back system itself and not a software value.

ISO

baseline value: 120

ISO is brightness value measuring the sensitivity of the camera. Apparent image grain increases as the ISO value is increased. Since ISO values are linked to other specifications, it is generally used to adjust overall tone or color balancing. Viewfinder software only allows ISO to be adjusted in 1/10th f-stop increments

Line time

baseline value 1/40

Line time is the exposure time of the CCD to light during the image capture process and effects the speed of scan. It is adjustable in 1/3 f-stop increments from 1/8 to 1/240 second per line. The Line time multiplied by the number of pixel lines in the image determines the total scan time. A baseline value is 1/40, but the final value will be adjusted for an individual scanning job's lighting conditions and resolution targets.

RGB

Values of the primary colors channels (red, green, blue) used to create digital image. Also used in comparing similar quality settings for multi-page objects. If re-scanning is deemed necessary, these settings will be needed to re-create image and help in matching to originally scanned specs. (This element is actually broken out into three columns in the worksheet. This primarily allows for easier input but also allows for greater analysis of data such as calculating averages and sorting.)

Tone curve profile

Repro 2.2 v2

Color profile

Value: adobeRGB1998 OR Custom ICC.

Creation of custom color profiles requires special training.

Notes

Not mandatory. At operator's discretion. Any miscellaneous information or special conditions that occurred during scanning.

Example:

Filename modification

Use custom ICC profile

Detail technical metadata is not currently transferred into the data repository. Compiling a summary technical metadata element is suggested and inline with Dublin Core metadata best practices[27]. This element can be compiled from the technical data (file level) and transferred to the main metadata worksheet (which is at the object level) for uploaded to the repository. High level technical metadata at the object level is automated during ingest such as file size, extent and type.

Workflow

This section provides operational guidelines for the creation of master digital images. These instructions are specific to our better light scan back system and particularly for archival type materials.

In general workflow can be divided into four main sections:

- Preparation (basic equipment set up, proper handling of materials)
- Acquiring Image (calibration of system including: focus, monitor calibration, color matching, scanning specifications)
- Validating quality of image captured and
- File management: applying proper file naming, storage, and documentation

Operational Instructions

The following is a basic workflow appropriate for most textual materials. When color critical work is needed, custom color profiles should be created.

Basic Workflow

A. Equipment Set Up

1. Turn on Tungsten lights with foot switches - two inner lights of each set
2. Remove lens cap.
3. Turn overhead lights **off**.
4. Turn computer on, open Viewfinder scanning software.
5. Keep the door almost **closed** while scanning.

B. Determine Image Size, Resolution, dpi

1. Place material on book cradle and Measure the physical pages of the item.
2. press PRESCAN button
3. Select SIZE tab

[27] CDPDCMBP p45 http://www.cdpheritage.org/digital/index.cfm

4. Set the DPI to 400 for text or 600 for images
5. Adjust the Crop Area to fit the image with a thin border
6. Set RESOLUTION w/in range: 50% - text thru 75% - images

C. Focus

1. Place focus card on the same plane as the page, not on the glass above
2. Select FOCUS tab panel
   - Slider should be on 8x (magnification setting)
   - **Only green dot** should be selected (shown as gray background on icon)
3. Click on PRESCAN button (to show focus card)
4. Click focus pointer over focus card (dotted-line <u>perpendicular</u> to card lines)
5. Click GO button
6. Adjust camera focus until bars peak or the number becomes highest (use the camera's focus knob directly on scanner equipment, near lens)
7. Press STOP when highest value is obtained
   - TIP: use SUPERVIEW to verify focus
8. If focus is still poor, Adjust camera head height and repeat steps B-C

D. Exposure, Color and Tone

1. Goto Tone Tab
2. Verify **tone profile** selection - Repro 2.2 v2
3. Goto Color Tab
4. Verify **color profile** selection - adobeRGB1998
5. Place Macbeth ColorChecker™ in center of document and on the same plane as the material.
6. Do a normal PRESCAN not FAST Prescan.
7. Place the SPOT METER Tool in the middle **two gray squares**
8. press AUTO-BALANCE.
9. Place a SPOT METER Circle on the white square of the Color Checker.
10. Validate White marker is in range 240 to 245 (only green color channel)
    - If white value not in range, adjust using ISO
11. Clear spots meter
12. Remove color/focus cards
13. Do a normal PRESCAN not FAST Prescan.

REPEAT: calibration every 10 scans or at beginning of new job

E. Assess Quality
- Prior to final Scan, Re-Verify scanning specs are all within acceptable parameters. If need to change any values, then Repeat steps B thru D.
- Assign filename and verify that it is correct (see file naming document for rules)

F. Create Final (MASTER TIFF) Scan
- TIP: Use scanning time to complete metadata records

G. Post Processing Quality Review
→Open Photoshop
- View image at full resolution (100%) and review for detail and sharpness (ie Is focus good?)
- Validate that all pages are turned to their proper orientation
- Visually check for any missing or mislabeled pages (ie file names match actual pages?)

- View Image for overall tonal and color quality.
    a. Open several previous scans from the same item.
        i. try to match these as closely as you can. Tip: note what settings were used for these scans and compare to existing image.
    b. Always review first scan of the work session or job, by comparing the first scan of the day to the related adjacent scans.
    c. Visually check that no distortion or blemishes obscure the legibility due to photo processing (i.e. that a blemish is not part of the original text and or any glare from protective covering is minimized)
    d. Review Histogram for exposure.

- Check for completeness
    a. Scan image includes border w/ edge of document (ensure that no cropping of image itself has occurred)
    b. Scan the complete document including reverse side of pages, front and back matter, blank pages, hard coverings, spine, etc. Perform visual comparison of digitized images with original document.

H. Document Management
1. Use scanning time to complete metadata records

2. File Storage - At end of job (ie digital object) or every 10 scans
    - In ViewFinder (File> File Manager) and select all of your scans; Check “Open After Transfer” ; click the Retrieve button.

3. Transfer masters to File Server -- at end of work session
    - Open Finder > select Storage Drive on the left hand menu. (display your object/job folders.)
    - Open Images Alias folder (from desktop) – this is file server. (open directory Images/Americas/Masters)
    - Drag image files only (not folders) from Storage Drive to File Server...Masters folder

4. Update material log (google docs) for scan status (by object/job)

I. Clean up
1. Place the color card and focus card back in protective plastic sleeve when finished.
2. Replace cap on camera lens, turn off Tungsten lights
3. Place archival documents back in protective casing
4. Log off computer

Maintenance and tips

J. Monitor Calibration

1. Calibrate the monitor monthly. This will take about 8 minutes to finish.

OR

Calibrate if experience persistent color problems

OR

When starting a new scanning job, particularly books or lengthy paged documents or when switching to different type of material (e.g. printed book to map)

OR

When booting up a computer, if message “monitor ICC profile is too old” appears

2. Launch Eye-One Match software. Connect the Eye-One Display apparatus to the computer and place it on the monitor. Choose EASY mode, NOT ADVANCED, and follow the on screen instructions to do the calibration.
   a. In Easy mode, the monitor is calibrated to **Gamma2.2**.

3. **TIPS**: When calibrating a monitor try to ensure consistent viewing conditions[28]
   - Block off ambient lighting
   - Lighting around workstation is consistent with scanning work lighting
   - Do not manually adjust brightness or contrast controls on the monitor post calibration
   - Allow monitor to run at least 30 minutes to one hour prior to calibrating (to ensure running temperature)

K. Light bulbs
- Do not touch bulb surface
- Log changes to track frequency of replacement bulbs by light socket

1. Turn off power to lights (lights should be cool to the touch)
2. Unscrew thumbscrews on each side and flip cover up
3. Push wire lever back
4. Snap in bulb (but do not touch bulb face directly)
5. Pull wire lever forward
6. Flip cover back down and tighten thumbscrews
7. Record the date the bulb was changed on log

L. Lighting evenness test and adjustment (i.e. “white paper” test)
- **When**: Check lighting evenness whenever light stands are moved (usually when scanning oversized objects)

1. Place a large smooth sheet of white paper under the glass, filling up as much of the scanning area as possible (do not move the camera to get it to fill, just get a bigger paper)
2. Scan,
3. Click the **ToneZones** tool (button above the Scan window)
4. Place Spot Meter in the center and at the four corners (up to 12 spots available with View Finder 7.4)
5. Review only green channel values
6. TIPS:
   - If lighting is not centered (red zone is not a circle/oval in the middle of the paper) move the lights and scan again.
   - If lighting is centered and brightness is >245, lower ISO until values are between 240-245.
   - Avoid: setting of 255 which is pure white value and therefore no details (called a “blowout”)
   - At each corner ...Theoretical Goal is for each corner to have the same value. Commonly acceptable variance is difference of green value no bigger than 8.

---

[28] Davis, A. and Fennessy, P. (2001). Digital Imaging for Photographers. Italy: Focal Press. 4th edition. ISBN: 0240515900

- At any two arbitrary points… If the difference in values is between 1 or 2, that means the lighting is very even. If the value difference is below 10 points, it is still considered good.
- Trial and error approach: If lighting is not even, there is no formula about how to adjust it. You just need to move the lights back and forth and around until the right lighting is achieved. The larger the scanning area, the farther the lights should be.

M. Reconfigure or creation of color profile (custom ICCs)

- **When**: Applies for color critical jobs only.
- NOTE: color profiles are highly sensitive to light; any change in position of lighting stands will render profile inaccurate.
- TIP: Try to complete work with out moving lights if possible. (Lights are usually moved to adjust light balance during the configuration of oversize items)

1. Place the MacBeth Color Checker under the glass on plane level with document to be scan
2. Scan
   - To ensure correct calibration, select "None" for color profile under the COLOR tab.
3. Open in PhotoShop and go to Filter → PictoColor → **InCamera 4.0.1**
4. Position the flexible facsimile grid over the color chart in the image (ie. match the squares with the frame) and press okay.
5. Save the ICC Profile,
6. Then select ICC profile in Viewfinder from the COLOR tab

- TIP: When assigning profiles to other images, select profiles that were created under similar lighting conditions.
- inCamera® 4.5 User Guide http://www.pictocolor.com/UserGuides/inCamera40/index.html

N. Software/Hardware updates to Betterlight computer workstation

- Best practices require re-calibration and or performance testing of any critical systems (such as monitor calibration, color and tone profiles) when any of the system hardware or software is changed or updated[29].

- Software (e.g. photoshop) is typically updated when IT group normally updates library computers. However, before any software updates are applied to the Betterlight workstation, system administration should first verify that critical functionality is compatible with existing scanning software such as Viewfinder, Eye-One match and Betterlight system.

[29] NARA p26

Quality controls - quick reference

A checklist of key quality measures that should be applied in the creation of digital images.

A. Pre- Processing

→In Viewfinder, prior to final scan:

- Verify scanning parameters are set within predetermined specs
    a. Resolution 50% Text thru 75% Image (≯ 100%)
    b. DPI: 600 image, 400 text
    c. Close match of digital image dimensions to size of physical document
    d. Color profile: adobeRGB1998 or specify custom icc
    e. Tone profile: Repro 2.2 v2
    f. ISO > 120 (≯ 1000)
    g. Line time > 1/40
    h. camera position : 980-990 approx range for regular size documents

B. Post Processing

→Open Photoshop

- View image at full resolution (100%) and review for detail and sharpness (ie Is focus good?)
- Validate that all pages are turned to their proper orientation
- Visually check for any missing or mislabeled pages (ie file names match actual pages?)

- View Image for overall tonal and color quality.
    a. Open several previous scans from the same item.
        i. try to match these as closely as you can. Tip: note what settings were used for these scans and compare to existing image.
    b. Always review first scan of the work session or job, by comparing the first scan of the day to the related adjacent scans.
    c. Visually check that no distortion or blemishes obscure the legibility due to photo processing (i.e. that a blemish is not part of the original text and or any glare from protective covering is minimized)
    d. Histogram

- Check for completeness
    a. Scan image includes border so edge of document is (ensure that no cropping of image itself has occurred)
    b. Scan the complete document including reverse side of pages, front and back matter, blank pages, hard coverings, spine, etc. Perform visual comparison of digitized images with original document.

C. File management

- Transfer TIFF (master) files to Image File Server
- Ensure technical metadata is complete
- Update material log (google doc)

D. Care and Handling of archival materials[30]

1. Wipe glass with cleaning wipes and dust surfaces, any dust or smudges will show up in scan.
2. Protecting the Material
   - Be very careful when scanning the book not to damage the spine or any of the pages. Do not press down too hard on the book.
   - Use archival foam wedges and linen string to support book and hold pages open for scanning.
   - Be sure to place the book on the storage shelf when you're done scanning; we want to be careful that it doesn't get misplaced.
   - please **No Food or Drink** in the scanning room.
   - Do not have anything near the book that might damage it, such as markers or pens, etc.
   - If you need to be away from the area where you are scanning the book for more than a few minutes, please place the book in the protective boxes.
3. For flat items:
   - Place black metal flat surface on foam rests, be sure rests are snug against edges of metal surface (this ensures that the stand is square and scans will not be crooked)
   - Line object up using straight edge or triangle — make sure the item or page is straight on the scanner
4. For books and bound items:
   - Find a mock book of similar size to set up angle of book back
   - Use bars, foam wedges, linen string, etc. to support book spine with one page under the glass at a time
   - Scan odd and even pages separately to minimize book handling, i.e. scan all odd then all even or vise versa

Derivatives

Purpose for derivatives creation is to provide an accurate rendition of original that is easily accessible by end user. Derivatives (jpeg and gifs for thumbnails) are batched processed using a freely available application, IrfanView.

Technical Support

Betterlight User Forum list

http://www.betterlight.com/ownersForum.html

[30] Review section on Care and Handling of materials in appendix for in depth guidelines.

White Papers and Articles

In-Depth Technical Information related to High-Resolution Digital Capture;
http://www.betterlight.com/whitePapers.html

Quick reference- Viewfinder Software Screen Guide

http://www.betterlight.com/downloads/Product-Info/viewfinder5.pdf

Online tutorials

Online tutorials, descriptions of controls and display for Viewfinder software.
http://www.betterlight.com/viewFinder.html

Online manuals and technical guides

http://www.betterlight.com/manualsTutorials.html

Future activities

Being part of a learning organization, means we are constantly looking for ways to enhance our patrons experience and improve our internal processes. Below are some topics we are investigating in the area of digital imaging technology.

- A future enhancement for access images is to implement JPEG2000 across institutional repository collections. This will improve user experiences by allowing users to magnify images directly online rather than downloading an image and then opening it in an image editor. Still undecided is whether this technology is a suitable format to replace our Tiff masters.
- Automate technical metadata – there are a number of tools to extract metadata captured during the scanning process and stored in the tiff header.[31] Consideration should be given to digital specifications that are not captured in the tiff header because these are physical settings on our scan-back system (e.g. camera position, f-stop setting, etc) rather than inputs in the capture software itself.
- Embed metadata – directly "tag" selected information to images through post-processing. This may be used to "stamp" images with general information about the publisher or original source.
- Preservation metadata – Researching how we may integrate technical metadata to emerging standards in preservation metadata (e.g. PREMIS)
- Continuing efforts to locate a flexible digital workflow management tool that will integrate with our existing information architecture.

[31] Cairo tools survey. May 21, 2007 access at: cairo.paradigm.ac.uk/projectdocs/cairo_tools_listing_pv1.pdf

Appendix

Care and handling of original materials

Good practices for digitization begin with the proper care and handling of the physical materials. Scanning operators are responsible for the care of these materials while in their possession and should follow Fondren Library's preservation policy. Please contact the preservation librarian or collection archivist if any questions should arise. These guidelines are general in nature and address archival or other special collections materials such as rare books, manuscripts, photographs and other artworks.[32] Specific techniques for work with the Better Light scan-back system are provided in the operational instruction section of this document.

Start up

1. Start with a clean work area. Even the slightest bit of dirt can damage manuscript materials. This includes ensuring that dust does not accumulate around materials, storage shelves or equipment.

2. Wash and dry hands prior to handling materials. Avoid touching hair or face or using hand creams during scanning work. This will help ensure sweat, grime and oil which can damage materials is minimized.

3. Do not bring any food or drink into the work area.

4. Do not use ink of any kind around materials such as pens, markers or highlighters. (A soft graphic pencil is appropriate though no pink erasers).

Preparing documents for scanning

5. For any uncut pages, please contact archivists. Do not attempt to repair any items.

6. Loose pages or particularly fragile papers should be enclosed in polyethylene sleeves (sometimes referred to by their trade name – Mylar). Since these sheets are transparent, materials may be scanned within their protective covers.

7. To avoid any structural stress to materials, particularly tightly bound items:

   - support materials using the cradle and or book stand

   - prop materials using soft archival book wedges or weighted linen string

[32] These guidelines are borrowed heavily from the following sources:

- Library of Congress National Digital Library Program and the Conservation Division, "Session on Care and Handling of Library Materials for Digital Scanning: Safe Handling of Library Materials – Review of Practices" (1999). http://memory.loc.gov/ammem/techdocs/conserv83199b.html
- Care and Handling Guidelines. National Library of Australia. http://www.nla.gov.au/digital/care_handling.html
- Good handling principles and practice for library and archive materials. National Preservation Office, British library. (2000) http://www.bl.uk/services/npo/pdf/handling.pdf

- use 120 degree as the maximum opening angle that a bound item should be subjected to or 90 degrees if item is tightly bound
- do not use excessive force when opening a spine or apply hard or abrupt pressure to pages while opening them

Handling materials

8. General rule of thumb is to handle materials as little as possible,
    - For example: A scanning operator should make use of a “mock” book of similar size to original to help find a proper arrangement while setting up the book cradle.
9. Avoid direct touching of surfaces.
10. Use cotton gloves when handling photographs. Photographs are particularly sensitive to oil on hands, which can reappear even after washing.
11. Handle transparencies or photographs by their edges.
12. Use acid-free paper strips as book marks. Do not fold down page corners. Do not make any marks on the materials. No not use staples, paper clips, rubber bands, adhesive tape or post-it notes.
13. Minimize exposure to high intensive lighting, especially photographs or colored artwork, as such damage is generally cumulative.

Storage

14. Do not place materials on floor.
15. Materials should be stored flat on shelves between acid free folders or archival boxes.
16. Do not stack books more than 3 items high.
17. Do not leave materials on scanner overnight; they should be storage away when not in use or returned to secure archives.
18. Keep archival materials in the order received. This will help minimize handling as well as keep records in their proper archival order.

Resources

Arms, Caroline R. and Carl Fleischhauer. Sustainability of Digital Formats: Planning for Library of Congress Collections. http://www.digitalpreservation.gov/formats/index.shtml

Besser, Howard. Getty Research Institute, Introduction to Imaging. http://www.getty.edu/research/conducting_research/standards/introimages/intro.html

Better Light web site. What kinds of lighting can be used with a scanning back? http://www.betterlight.com/faq_sales.html#faq9

Better Light web site. What Makes the Scanning Back Unique? http://www.betterlight.com/how_they_work.html

Collaborative Digitization Program (2006). Dublin Core Metadata Best Practices. (CDPDCMBP) http://www.cdpheritage.org/cdp/documents/CDPDCMBP.pdf

Cornell University Library Research Department. (2003). Moving Theory into Practice Digital Imaging Tutorial. http://www.library.cornell.edu/preservation/tutorial/contents.html

Davis, A. and Fennessy, P. (2001). Digital Imaging for Photographers. Italy: Focal Press. 4th edition. ISBN: 0240515900

Digital Library Federation Benchmark Working Group (DLF) (2002). Benchmark for Faithful Digital Reproductions of Monographs and Serials. Version 1. http://www.diglib.org/standards/bmarkfin.htm

Library of Congress National Digital Library Program and the Conservation Division, "Session on Care and Handling of Library Materials for Digital Scanning: Safe Handling of Library Materials – Review of Practices" (1999) http://memory.loc.gov/ammem/techdocs/conserv83199b.html

National Initiative for a Networked Cultural Heritage (NINCH). (2002). The NINCH Guide to Good Practice in the Digital Representation and Management of Cultural Heritage Materials. 2002. http://www.nyu.edu/its/humanities/ninchguide/

National Library of Australia. Care and Handling Guidelines. http://www.nla.gov.au/digital/care_handling.html

National Library of Australia. Digitisation of Traditional Format Library Materials – Guidelines. http://www.nla.gov.au/digital/standards.html

National Preservation Office, British library. (2000) Good handling principles and practice for library and archive materials. http://www.bl.uk/services/npo/pdf/handling.pdf

Sitts, M.K. (ed.) (2000). Handbook for Digital Projects: A Management Tool for Preservation and Access. Andover, Massachusetts: Northeast Document Conservation Center. (NDCC). Andover, Massachusetts. http://www.nedcc.org/oldnedccsite/digital/dighome.htm

U.S. National Archives and Records Administration (NARA). (2004). Technical Guidelines for Digitizing Archival Materials for Electronic Access: Creation of Production Master Files – Raster Images. http://www.archives.gov/preservation/technical/guidelines.html

Western States Digital Standards Group. Digital Imaging Best Practices. January 2003. http://www.bcr.org/cdp/best/index.html