Creating Permanent and Durable Information
Physical Media and Storage Standards

The following outline provides references to guidance on the creation and management of durable copies of information, including paper records, microfilm, photographs, and digital images.

Systems Perspective: Standards Overview

Standards organizations can be grouped into three categories:

Industry Standards

AIIM—Association for Information and Image Management
ANSI—American National Standards Institute
ASTM—American Society for Testing and Materials
ISO—International Standards Organization
NISO—National Information Standards Organization
PIMA—Photographic and Imaging Manufacturers Association

User-Group Standards

RLG—Research Libraries Group

Government Standards

CFR—*Code of Federal Regulations*

Life Expectancy

ANSI and PIMA have adopted the following definitions relating to the longevity of imaging materials. ISO has also adopted several of these definitions.

Archival Medium is a recording material that can be expected to retain information forever, so that such information can be retrieved without significant loss when properly stored. However, there is no such material, and it is not a term to be used to describe material or system specifications in American National Standards.

Life Expectancy (LE) is the length of time that information is predicted to be usable in a system at 21° C and 50% relative humidity (RH). The latest photographic film standards use this definition. An alternate definition is that LE is the length of time that information is predicted to be retrievable in a system under extended-term storage (definition used in photographic print standards).

LE Designation is a rating for the life expectancy of recording materials and their associated retrieval systems. The number following the LE symbol is a prediction of the minimum life expectancy in years for which information can be retrieved without significant loss when stored at 21° C and 50% RH. LE-100 indicates that information can be retrieved after at least 100 years storage.

Extended-Term Storage Conditions are storage conditions suitable for the preservation of recorded information on the majority of freshly processed photographic films for 500 years (definition in latest photographic film standards). The previous definition of this phrase referred to storage conditions suitable for the preservation of recorded information having a permanent value.

Medium-Term Storage Conditions are storage conditions suitable for the preservation of recorded information for a minimum of 10 years.

Life Expectancy (LE) Ratings

LE ratings have been assigned for the following types of photographic film materials:

Black-and-white (B&W) polyester-based photographic films	LE-500
B&W acetate-based photographic films	LE-100
Diazo microfilm	LE-100
Vesicular microfilm	LE-100
Thermally processed silver microfilm (dry silver)	LE-100
Polyester-based magnetic tape	LE-50

Research is being conducted to determine the LE ratings for other materials, but no other LE ratings have been assigned at this time. Accelerated aging studies indicate that digital optical media will last between 30 and 200 years (the physical longevity is very specific to the type of disks and the manufacturer due to differences in the dyes used). **However, the system obsolescence of digital data may be only 5 to 10 years (often less) and is the critical factor in migrating data to new technologies or systems.**

In the fall 1998 *AIIM Review,* 10 technologies were listed that will affect document management over the next two years. Number five on this list was replacement of optical disk systems with computer output microfiche. A large market is emerging for computer output microfilm for all companies that were early adopters of optical disk storage. These companies are finding the cost of maintenance and migration of optical digital storage prohibitive.

Comparison of Information System Models

Preservation Microfilm Model

- Information is human readable with magnification only.
- Life expectancy of 500 years when stored properly.
- Need to duplicate only every 50 years to produce new printing master.
- Lower cost to store.

Digital Preservation Model

- Machine readable only, very system dependent.
- Life expectancy of system only 5 to 10 years.
- Need to refresh (recopy) an average of every 5 years through data migration and
- Software/hardware upgrades necessary.
- Higher cost to maintain data (cost is expected to continue to decrease at a rapid rate).

Physical and Chemical Stabilty Standards

Standards exist that specify the properties for the following areas relating to the long-term keeping of recorded information. Use them when planning documentation projects. They include physical and chemical stability standards, such as the following:

Paper Permanence

ANSI/NISO Z39.48-1992-Permanence of Paper for Publications and Documents in Libraries and Archives.
National Archives and Records Administration Bulletin No. 95-7.
Joint Committee on Printing A270.
ISO 9706 and ISO 11108.

Inks

1987 UNESCO *RAMP Survey*.

Specifications for Stability of Photographic Materials

ANSI IT9.1-1996 / ISO 10602-1995 Processed Silver-Gelatin Type, Black-and-White Film.
ANSI IT9.5-1996 / ISO 8225 Ammonia-Processed Diazo Photographic Films.
ANSI IT9.12-1995 / ISO 9718 Processed Vesicular Photographic Film.
ANSI IT9.19-1994 Thermally Processed Silver Microfilm.

Test Methods for Stability of Photographic Materials

ANSI IT9.9-1996 Stability of Color Photographic Images—Methods for Measuring.
ANSI IT9.21-1996 Life Expectancy of Compact Discs (CD-ROM)—Method for Estimating.

Test Methods in Progress

PIMA IT9.26 Life Expectancy of Magneto-Optic (MO) Disks.
PIMA IT9.27 Life Expectancy of Information Stored in Recordable Compact Disc Systems.

Storage

The following storage standards provide specific recommendations for the proper storage of materials.

NISO TR01-1995 Storage: Paper Records.
ANSI/PIMA IT9.11-1998 / ISO 5466 Storage: Photographic Film.
ANSI/NAPM IT9.18-1996 / ISO 3897-1997 Storage: Photographic Plates.
ANSI/NAPM IT9.20-1996 / ISO 6051-1997 Storage: Photographic Prints.
ANSI/NAPM IT9.23-1997 Storage: Magnetic Tape
ANSI/PIMA IT9.25 Storage: Optical Disc Media

The recommendations above fall into two categories of storage—*general* storage and *cold* storage.

The following general conditions come closest to meeting all the environmental requirements in the above standards for extended term storage:

General Storage: 68° F (18° C)
30% to 40% relative humidity

These storage conditions are appropriate for extended-term storage of:

paper records
B&W polyester-based photographic film and prints
photographic plates
magnetic tape
optical discs

Cold Storage: 35° F (2° C)
30% to 40% relative humidity

These cold storage conditions are appropriate for extended-term storage of:

B&W acetate-based photographic film
color photographic film
chromogenic color photographic prints
color hardcopy output

Note: Users of cold storage need to remember that the time materials are out of cold storage will mitigate the benefits of the cold storage, so time out of storage should be kept to a minimum.

Enclosures (Institutional Specifications)

ANSI IT9.2-1996 Photographic Processed Films, Plates, and Papers—Filing Enclosures and Storage Containers.
ANSI IT9.16-1993 Photographic Activity Test.

Preservation Planning

Traditionally, the selection and planning for preservation was based on the needs of the materials, such as brittle paper or deteriorating film. Over the last 10 years there has been national initiatives to integrate the archival, curatorial, and/or institutional needs with the needs of the materials. The tools used for selection and planning include appraisal, surveys, and preservation selection models.

A more sophisticated planning approach—the cost-benefit analysis—can be used to prioritize preservation activities. See "Negative Duplication" in *Topics in Photographic Preservation,* 3 (1989), pp 123-134.

Reformatting

Standards and guidelines exist for the reformatting of a variety of records.

Electrostatic Photocopy Quality

Use archival bond paper.
Use carbon-black based toner.

Note: For further information see *NARA Technical Information Paper (TIP) No. 5,* Archival Copies of Thermofax, Verifax, and Other Unstable Records, 1990. Copies should pass the peel-test for toner adhesion that is described in this paper.

Microfilm Procedures and Quality

AIIM / ANSI standards.
Research Libraries Group *Preservation Microfilming Handbook*.
CFR Part 1230—Micrographic Records Management.

The above sources provide standards and guidance for records preparation, targets, background density, resolution, QI (quality index), residual hypo and silver, film base, and the quality of duplicates.

Photographic Copying and Duplication

Approaches to Duplication of Historic Black-and-White Photographic Negatives

Interpositive / duplicate negative method—2 steps: best tonal accuracy.

Direct duplicate negatives—1 step: least generational loss; hard to work with and maintain image detail.

Print and copy negative: easiest to do, but lowest quality.

See the following Kodak publication: *Photographic and Digital Imaging Techniques,* M-1, CAT No. E152 7969, Eastman Kodak.

Approaches to Photographic Tonal Reproduction

Standardized Exposure—traditional approach: potential for loss of detail with dense negatives and negatives with large density range; shadow mask optional (technique developed by Chicago Albumen Works).

Shadow Normalization (NARA/Library of Congress)—minimizes loss of detail, produces consistent duplicate negatives, and allows for objective evaluation of tone reproduction.

Hybrid Standardized Exposure with Highlight Normalization—has benefits of both techniques.

Specifications

National Archives and Records Administration/Library of Congress specifications (available from the author of this outline). The NARA/LC duplication specifications have:

applied the concept of statistical process control to the duplication of negatives;

measured the variability of duplication systems;

determined +/- limits for the average contrast and average shadow density of duplicates;

determined +/- limits for individual duplicates for contrast and shadow density; and

required evaluation based on a random sample.

For guidance on how to select the best approach for duplicating historic negatives, see Puglia, Steven."Negative Duplication: Evaluating the Reproduction and Preservation Needs of Collections," *Topics in Photographic Preservation,* Vol. 3, American Institute for Conservation, Washington, DC.

Digitizing Standards and Initiatives

Standards and guidelines that define the best practices and the test methods for evaluating both scanner performance and digital image quality are not as well developed at this time for digitizing as they are for microfilming. Existing standards and guidance include:

AIIM standards and technical reports.

AIIM Document Management Alliance (DMA).

AIIM Open Document Management API (ODMA).

RLG working group on digital image capture.

RLG working group on digital archiving.

Digitizing Standards in Progress at PIMA

Measure noise.

Measure spatial frequency response (SFR).

Test objects and procedures for the color characterization of electronic still cameras.

Color Management Activities

International Color Consortium (ICC) Digitizing guidelines.

Digital Project Guidelines

For Scanning Textual Documents:

200 to 600 pixels per inch (ppi) for 1-bit scanning.

200 to 400 ppi for 8-bit greyscale scanning.

200 to 300 ppi for 24-bit color scanning.

For Scanning Photographs:

3,000 to 5,000 line files for 8-bit greyscale scanning.

3,000 to 5,000 line files for 24-bit color scanning.

For Scanning Maps/Plans/Oversized Materials:

200 to 300 ppi for 8-bit greyscale scanning.

200 to 300 ppi for 24-bit color scanning.

Cornell University Library Scanning Recommendations for Printed Type

Scan at:

600 ppi for 1-bit scanning.

400 ppi for 8-bit greyscale scanning.

NARA Digitizing Guidelines

NARA guidelines provide the minimum digitizing requirements for on-line access being used for the Electronic Access Project, and include guidance on quality assurance procedures and records handling guidelines. See them on the Web at: <www.nara.gov/nara/vision/eap/eapspec.html>

Images scanned for on-screen representation on a generic or "average" monitor.

Grayscale and color scanning of reflection materials in reference to a Kodak grayscale to ensure accurate tonal representation and neutral color balance.

Aimpoints established for three steps on the Kodak grayscale.

Plus or minus variability limits established for RGB levels (color scanning) and % black (grayscale scanning) for three aimpoints.

Digital Resolution for Photographs

Access screen resolution: minimum of 600x400 pixels

Reproduction: 3,000 line file-
8"x10" photo quality output
11"x17" magazine halftone

Preservation: match the original (color negative or transparency)-
3,000 to 4,000 lines for 35mm
10,000 lines to 16,000 lines for 4"x5"
20,000 lines to 32,000 lines for 8"x10"

Machine Dependant Media Types

Photographic and motion picture.

Magnetic—audio, video, and digital data.

Optical—audio, video, and digital data.

The media listed above need an active program for the frequent migration of recordings and digital information.

Steven Puglia
Preservation and Imaging Specialist
National Archives and Records Administration